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CYCLOPÆDIA

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PRACTICE OF MEDICINE.

Edited by Dr. H. von ZIEMSSEN,

PROFESSOR OF CLINICAL MEDICINE IN MUNICH, BAVARIA.

VOL. IV.

DISEASES OF THE RESPIRATORY ORGANS.

By DR. FRAENKEL of Berlin, PROF. von ZIEMSSEN of Munich,
PROF. STEINER of Prague, DR. RIEGEL of Cologne, and
DR. FRAENTZEL of Berlin.

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ERRATA.

VOL. I.

Page 64, last line, after the word " deviations " supply the words " in different."

VOL. III.

Page 59, first line, " through " should be " thorough."
Page 60, twelfth line from the top, " than " should be " that."
Page 84, eleventh line from the bottom, expunge the word " not."
Page 84, tenth line from the bottom, " later " should be " latter."
Page 120, twelfth line from the bottom, " on " should be " an."
Page 142, tenth line from the bottom, " indentical " should be " identical."
Page 174, fourteenth line from the top, " ridge " should be " bridge."
Page 177, second line from the bottom, " both " should be " the."
Page 208, thirteenth line from the bottom, " sympto " should be " symptoms."

VOL. IV.

Page 129, in the title of the section, " Blenorrhoica " should be " Blennorrhoica."

VOL. V.

Page 197, eighth line from the bottom, " atalectatie " should be " atelectatie."
Page 272, fourteenth and twentieth lines from the top, " crisis " should be " erasis."
Page 607, ninth line from the bottom, " it " should be " them."

EDITOR'S NOTE.

The sections on Whooping-Cough, and on Œdema, New-Growths, Ulcers, Neuroses, etc., of the Larynx, belong properly in this volume; but as it has already reached a greater bulk than any previous one, the publishers have decided to incorporate these chapters into Volume VII.

BIOGRAPHICAL SKETCHES OF THE AUTHORS.

BERNARD FRAENKEL was born on the 17th of November, 1836, in Elberfeld. He attended the High School of the latter place and the Universities of Wurtzburg and Berlin. The degree of doctor was obtained in Berlin, where he also passed his state examination, and served his term of voluntary service in the capacity of a one-year military sub-surgeon. He then settled in Berlin as a practising physician, and has continued the practice of medicine there, except during the time of his service in the wars of 1864, 1866, and 1870-71. In the year 1871 he became a private instructor, and in 1873 and 1874 physician in charge of the Augusta Hospital. He has published a number of articles for the journals, among which we select: Experimental Investigations on the Conveyance of Tuberculosis to Animals (in co-operation with Prof. Cohnheim), Virchow's Archiv, Band 45, p. 216; Tuberculosis of the Choroid, Jahrb. f. Kinderheilkunde, II., p. 113; Laryngoscopic Illumination, Deutsches Archiv f. klinische Medizin, XII., p. 541.

JOHANN STEINER was born at Joachimsthal in the Bohemian Erzsgebirge, on July 2d, 1833. He studied under the greatest privations, as he was unable to rely upon any support from his parents. He attended the Obergymnasium of Komotau, and in 1852 he commenced the study of medicine in Prague. Twice he was on the point of abandoning the profession, because he was utterly without means, yet he always persisted until finally he found a patron in the founder and director of the Children's Hospital in Prague, Professor Löschner, who gave him assistance. In the sixth semester of his course this friend obtained for him a permanent home in the Children's Hospital, and it was in this way that he early turned his attention particularly to the study of children's diseases.

In the year 1858 he obtained his degree as doctor; in 1862 he became private instructor; and in 1866, Extraordinary Professor of Children's Diseases. In this position he is still active, and is also chief of the Pædiatric Clinic in the Francis Joseph Children's Hospital of Prague.

The following of his scientific works have been published:

1. On Lobular Pneumonia of Children, Prager Vierteljahrschrift, 1862, Band III.

2. Pædiatric Communications from the Francis Joseph Children's Hospital of Prague (Steiner and Neurother). (Treatises of some length on the most important subjects in Pædiatrics, 1862-1863.)

3. Fatty and Amyloid Degeneration of the Liver in Childhood (Steiner and Neurother), Jahrbuch für Kinderheilkunde, 3. Jahrgang, Heft 3 und 4.

4. A Contribution to Stenosis in Childhood, Jahrbuch für Kinderheilkunde, 1867, 7. Jahrg., 2. Hft.

5. On Tracheotomy in Croup, Jahr. f. Kinderheilkunde, 6. Jahrg., 2. Hft.

6. Bronchitis Catarrhalis Sicca in Children, Jahrb. f. Kinderheilkunde, 1868.

7. A Contribution to the Nature of Chorea Major and Catalepsy, Jahrb. f. Kinderheilkunde, 2. Jahr., 2. Hft.

8. A Traveler's Studies in the Domain of Pædiatrics in their Relation to Orthopædics in Childhood, Prager Vierteljahrschrift, B. 85.

9. Epithelioma Laryngis, Jahrb. f. Kinderheilkunde, 1. Jahr., 3. Heft, 1868.

10. History of the Francis Joseph Hospital in Prague, Jahrb. f. Kinderheilkunde, 3. Jahrg., 2. Hft.

11. On Roetheln, Archiv f. Dermatologie und Syphilis, 1869, 2.

12. On the Treatment of Hereditary Syphilis, Oesterreich. Jahrb. der Pædiatrik.

13. The Cause of Cerebral Symptoms in the so-called Cerebral Pneumonia of Children, Jahrb. f. Kinderheilkunde, 2. Jahrg., 1. Hft.

14. Experiences in regard to the Simultaneous Appearance of the Acute Exanthemata in one and the same Person.

15. On the Therapy of Diphtheria, Jahrb. f. Kinderheilkunde, 4. Jahrg., 1. Heft.

16. Epidemic of Chorea Minor, Jahrb. f. Kinderheilkunde, 3. Jahr., 2. Heft.

17. Chloral Hydrate in Children's Practice, Jahrb. f. Kinderheilkunde.

18. Morbilli Bullosi s. Pemphigoidei, Jahrb. f. Kinderheilkunde, IV. J., 7. Heft.

19. Clinical Studies on Pemphigus in Childhood, Archiv f. Derm. und Syphilis, 1869.

20. The Diseases of the Cerebral Organs in Childhood (Steiner and Neurother), Prag. Vierteljahrschrift, Band 106.

21. Clinical Experiences in Chorea Minor, Ibid., Band 99.

22. Typho-Hydrocephalic Mania in an eight-year old Boy, Jahrb. f. Kinderheilkunde.

23. Night Terrors, or Night Screaming of Children, Ibid., 1874.

24. Compendium of Children's Diseases. Second edition. Leipzig, F. W. C. Vogel. (Translated into the Dutch, Hungarian, Italian, English, and Russian languages.)

25. On the Inoculation of Varicella, Wien. med. Wochenschrift, April, 1875.

FRANZ RIEGEL, the son of a practising physician, was born in Wurtzburg on the 9th of February, 1843. Having completed his studies at the High School, he entered the University of Wurtzburg in the autumn of 1861. For the first year he devoted himself to the study of the natural sciences, and then, in the autumn of 1862, turned his attention wholly to medicine. In the beginning of the summer semester of 1866, while still a student, being offered by Professor von Linhardt

the position of Assistant at the Surgical Clinic of Wurtzburg, he accepted it, and in the autumn of the same year became also a Gynecological Assistant at the Clinic of Professor von Scanzoni, holding the position for a considerable time. In the summer of 1866 he obtained the degree of doctor, his inaugural dissertation, published in the Wurtzburger medicinischer Zeitschrift, being, "The Respiratory Movements in Healthy and Diseased Persons." In this article he was the first to describe a practical stethograph, and contributed a large number of stethographic data which he had obtained in health and disease.

In the autumn of 1866 there was a vacancy in the position of assistant at the Medical Clinic, and having always had a decided preference for internal medicine, he accepted the position, becoming at first second assistant, and later first assistant at the Clinic of Professor von Bamberger. In the autumn of 1867 he passed his state examination at Munich. For almost six years he filled the position of assistant, just mentioned, at the Clinic of Professor von Bamberger, retaining it even for some time after the latter had accepted the call to Vienna. This period of his life, while acting as an assistant, was fruitful in a large number of works, in part of a clinical nature, in part relating to experimental pathology, and in part to physiology. His labors as a clinical assistant were continuous except so far as they were broken by a journey which he undertook for the purpose of visiting the larger universities of Germany, especially those of Berlin and Vienna.

In the summer of 1871 he became a private instructor in internal medicine at the University of Wurtzburg, and in the autumn of 1873, owing to the vacancy in the chair of Pathological Anatomy, which had been occupied by Professor Klebs, he was named as the provisional representative. In the year 1873 he published a monograph of some size, entitled "The Respiratory Movements," in which he gives a thorough description of stethography, which he was the first to raise to a scientific method of examination, and where he also details the results he obtained by his single and double stethoscopes in the examination of persons in health and disease.

In the spring of 1874 he received a call as Medical Director to the Medical Department of the great City Hospital in Cologne, which call he accepted, as it offered him rich scientific material. This position he fills at present.

The following is the list of his published articles :

On Respiratory Movements in Healthy and Diseased Persons, Wurzb. med. Zeitschrift, VII. Bd., 1866-7 (with a plate).

Intra-uterine Injections in the Treatment of Uterine Diseases, Deutsches Archiv f. klin. Med., V. Band.

On the Paralysis of Relapsing Fever, Deutsches Archiv f. klin. Med., VI. Band.

On the Paralysis of certain Muscles of the Larynx, Deutsches Archiv f. klin. Med., VII. Bd.

On the Pathology and Diagnosis of Mediastinal Tumors, Virchow's Archiv f. Path. Anat. u. Phys., Bd. XLIX., Heft 2 (with a drawing).

Contribution to the Knowledge of the Circulation of the Blood in the Smaller Vessels, Centralblatt f. die med. Wiss., 1870, No. 29.

On the Changes in the Vessels of the Pia in Consequence of the Irritation of Sensory Nerves, Virchow's Archiv f. Path. Anat. und Phys., Band. LII.

On the Reflex Innervation of the Blood-vessels, Wiener med. Jahrb., N. F., I.

On the Influence of Woorara on the Body Temperature, Centralblatt f. die med. Wiss., 1871, No. 26.

On the Double Souffle in the Femoral Artery in Insufficiency of the Aortic Valves, Deutsche Archiv f. klin. Med., Bd. VIII.

On the Influence of the Nervous System on the Circulation and the Body Temperature, Pflüger's Archiv des ges. Phys., Band IV.

Investigations on the Emetic Property of Apomorphia in its Physiological and Therapeutical Relations, Deutsches Archiv f. klin. Med., Bd. IX.

On the Results of the Cold-Water Treatment in Typhoid Fever, in the Julius Hospital of Wurtzburg, in the years 1870 and 1871, Deutsches Archiv f. klin. Med., Bd. IX.

Cases Illustrative of the Differential Diagnosis between Acute Emphysema and Circumscribed Pneumothorax, Bayr. ärztl. Intelligenzblatt, 1872, No. 16.

On the Relation between Vaso-Motor Nerves and Body Temperature, Pflüger's Archiv f. die ges. Physiologie, Band V.

On the Regulation of Heat and Hydrotherapy, Deutsches Archiv f. klin. Med., Band IX.

On the Paralysis of the Muscles which open the Glottis, Berl. klin. Woch., 1872, Nos. 20 u. 21.

On the Influence of the Central Nerve System on Animal Warmth, Pflüger's Archiv f. die gesammte Physiologie, Band V.

On Stethography and Stethographic Curves (with the description of a new Stethograph, 2 diagrams), Deutsches Archiv f. klin. Med.

On Abnormal Narrowing of the Aortic System, Berl. klin. Woch., 1872, Nos. 39–40.

On Hydrotherapy and Local Derivation of Heat, Deutsches Archiv f. klin. Med., Band IX.

Cases of Malformation of the Liver (with a plate).

On the Paralysis of the Muscles that open the Glottis, Berl. klin. Woch., 1873, No. 7.

A Case of Unilateral Injury of the Spinal Cord, Berl. klin. Woch., 1873, Nos. 18 and 19.

On Graphic Representation of Respiratory Movements (with a plate), Deutsches Archiv f. klin. Med. Blatt, XI.

On the Influence of Alcohol on Animal Warmth (with a plate), Deutsches Archiv f. klin. Med., Bd. XII.

On the Theory of Tetanus, Deutsches Archiv f. klin. Med., Band XII.

On the Theory of the Regulation of Heat, Virchow's Archiv f. path. Anat. u. Phys., Band LIX.

On the Therapeutic Action of Condurango Bark, Berl. klin. Woch., 1874, No. 35.

On the Regulation of Heat, Virchow's Archiv f. path. Anat., Bd. LXI.

The Respiratory Movements ; a Physiological and Pathological Study (with 12 drawings), A. Stuber, Wurtzburg.

On the Therapeutic Use of Jaborandi, Berl. klin. Woch., 1875, Nos. 6 and 7 ; Appendix, etc., Berl. Woch., No. 9.

On Chalicosis Pulmonum, Deutsches Archiv f. klin. Med., Bd. XIII.

Dr. OSCAR FRAENTZEL was born on the 4th of March, 1838, at Meseritz, in the Grand Duchy of Posen. His early education was obtained at the High School of Posen ; from Easter of 1856 to Easter of 1860 he studied medicine at the University of Berlin as a pupil of the Frederick William Institute. On the 15th of March, 1860, he received his degree as Doctor of Medicine. From Easter of 1860 to Easter of 1861 he served as Assistant Physician in the Charité, and it was here that his long services in connection with Traube's clinic brought him into close relations with this instructor. From 1861 to 1865 he served as an army surgeon on the Rhine, in Silicia, and during the Schleswig-Holstein campaign. In 1865, in the capacity of chief surgeon, he returned to the Frederick William Institute in Berlin, and worked there, chiefly under the supervision of Traube and Virchow. He also closely followed Cohnheim, Kühne, Rosenthal, Hermann, Gusserow, Hueter, etc. At Easter of 1867 he was holding the position of staff-surgeon and was assistant at Traube's clinic, and remained in this position until the autumn of 1869. In the winter of 1869–70 he became Private Instructor in Clinical Medicine at the Berlin University.

In December, 1869, he assumed the position of physician-in-charge of the department of internal diseases for the newly founded Augusta Hospital. Owing, however, to his being overburdened with other professional matters he gave up this position in the summer of 1873. On the 1st of July, 1870, he was appointed physician-in-charge of a department of Internal medicine of the Royal Charité Hospital, and since that time he has been very active as an instructor in auscultation and percussion. During the last few semesters he has also been giving laryngoscopic courses. In the winter semester of 1874–1875 and in the summer semester of 1875, the government commissioned him to take charge of the propadeutic clinic in place of Professor Traube, who was sick.

Among his literary publications are the following, exclusive of numerous communications from Traube's clinic, which were published in the Berliner klinischer Wochenschrift :

Contribution to the Knowledge of the Structure of Spinal and Sympathetic Ganglion Cells, Virchow's Archiv, XXXVII., p. 549.

A Case of Abnormal Communication of the Aorta with the Pulmonary Artery, Virchow's Archiv. XLIII., p. 420.

On Crises and Deliria in Relapsing Fever, Virchow's Archiv, L., p. 127.

Enterotomy in Ileus, Virchow's Archiv, L., p. 164.

On the Production of Hypertrophy and Dilatation of the Heart's Ventricles from the Over-exertions incident to War, Virchow's Archiv, LXII., p. 215.

On the Internal Use of the Sulphate of Atropia in Profuse Sweating, especially in the Night Sweats of Phthisical Patients, Virchow's Archiv, 1858, p. 102.

A Case of Acute Suppurative Mediastinitis in the Course of Typhoid Fever, Berliner klinische Wochenschrift, 1874, No. 9.

A new Kind of Trocar for withdrawing Pleuritic Effusions. Berliner klinischer Wochenschrift, No. 12.

CONTENTS.

Fraenkel.

GENERAL DIAGNOSIS OF DISEASES OF NOSE, PHARYNX, AND LARYNX.

                  (Translated by George M. Lefferts, M.D.)

                       DISEASES OF THE NOSE.

(Translated by Edward W. Schauffler, M.D.)

Von Ziemssen.

ANÆMIA, HYPERÆMIA, HEMORRHAGE, ABNORMAL COLOR, AND THE CA-
TARRHAL INFLAMMATIONS OF THE LARYNGEAL MUCOUS MEMBRANE.

Steiner.

CROUP.

(Translated by A. Brayton Ball, M.D.)

Riegel.

DISEASES OF THE TRACHEA AND BRONCHI.

(Translated by J. Solis Cohen, M.D.)

Fraentzel.

DISEASES OF THE PLEURA.

(Translated by J. Burney Yeo, M.D.)

THE

GENERAL DIAGNOSIS AND THERAPEUTICS

OF

DISEASES OF THE NOSE,
NASO-PHARYNGEAL SPACE, PHARYNX,
AND LARYNX.

———

FRAENKEL.

GENERAL DIAGNOSIS.

EXAMINATION BY THE EYE.

INSPECTION OF THE PHARYNX.

Next to the mouth the pharynx is probably more frequently inspected for diagnostic or therapeutic purposes than any other cavity of the human body, and it is therefore important not only that a systematic method of examination be observed, but that the examiner acquire the necessary dexterity in manipulation by sufficient practice.

If a patient be placed in a suitable light, with the mouth as widely extended as possible, more or less of the pharynx can be seen, the view embracing in certain cases not only the *pars oralis* and *pars laryngealis pharyngis*, but sometimes even the epiglottis, while in others the velum and uvula can scarcely be distinguished. The field of vision is then limited by the tongue. If this organ can be made to lie on the floor of the mouth, by the patient's own efforts, a view of the deeper portions of the pharynx is practicable; while this is prevented if the tongue is naturally very thick, or raises itself in the form of an arch.

In these latter cases it is necessary that *the tongue should be depressed*, and as this procedure will often be alluded to—not only here, but also in future pages, when considering the various other methods of examination—a careful consideration of the proper manner of performing the operation is advisable at this point. For simple inspection of the pharynx, it is of little importance how the tongue is prevented from obstructing the view, but for other purposes—especially for rhinoscopy, and for obtaining a view of the epiglottis without the use of further

appliances—a certain position, one inclining downwards and forwards, is necessary. The operator will therefore find it advisable to accustom himself from the commencement of his examinations not to press the tongue either directly downwards or backwards, but rather to *draw it forwards and downwards*, as by so doing the ascending portion of the root of the tongue, together with the epiglottis, will be drawn away from the posterior pharyngeal wall, and the view into the deeper parts of the pharynx be thereby rendered considerably more extensive. In exerting the necessary pressure, it should commence at that point where the horizontal portion of the dorsum of the tongue begins to incline downwards, and the direction given should be such that if the line of pressure were carried out it would strike the skin in front of and not behind the hyoid bone.

If the tongue is depressed in the manner described, the whole pharynx, as far as it is visible from the mouth—and very often the free edge of the epiglottis also—will be presented to the eye. If retching occur during the procedure, the purpose of the examination will only be facilitated, as during the act the larynx is elevated, while at the same time the tongue is depressed upon the floor of the mouth. It is sometimes found desirable purposely to excite retching, in order to increase the extent of the view into the pharynx, and this is easily accomplished by passing the tongue depressor far back upon the dorsum of the tongue. For the purposes of examination alone, however, it is very seldom necessary to excite the act, and if the tongue has been depressed as described, the operator will be able to see all that can be seen without the aid of other instruments, and without causing the patient to undergo a procedure which can but be very disagreeable to him. Allusion to this method is, however, necessary, as Voltolini, who is entitled to the credit of having first taught that the deeper parts of the pharynx can be seen from the mouth, if the operation be properly conducted, always excites retching for this purpose. His method of examination differs from the one here described, insomuch as he draws the tongue as far as possible out of the mouth, and then causes retching by depressing it strongly and carrying the spatula as

far backwards as possible.[1] It cannot be denied that this procedure, disagreeable as it is to the patient, sometimes permits of a much deeper view into the pharynx than can be obtained when the examination is made with the tongue lying behind the incisor teeth, and therefore deserves a trial when the operator is unable to effect his purpose by other means.

In order to depress the tongue, the finger—preferably the left index finger—or any other improvised means may be used, or instruments made especially for the purpose be employed. In either case care must be taken not to interfere with the necessary light, and consequently, in introducing the finger or the instrument, we should be careful to keep as close as possible to the incisor teeth.

If the operator uses his finger, or an instrument of like dimensions, it should be introduced from the corner of the mouth, or, if spaces exist between the teeth, through these. In order to prevent the finger from being bitten by children or fainting patients, it may be guarded by a broad metal ring, which is prepared for the purpose, or the lower lip of the patient may be carried over the teeth with the finger when introducing it. The patient will then avoid attempts at biting, as by so doing he pinches his own lower lip, which lies between his teeth and the operator's finger.

Improvised instruments usually consist either in the handle of a spoon, a pen handle, a pencil, or something of a similar nature, which is found at hand. The *instruments prepared especially* for the purpose are termed *tongue* or *mouth spatulas* —a designation obtained from the original form of the instrument, which subserved the double purpose of depressing the tongue and spreading ointments, and although many of them are less practical than the handle of a spoon for the purpose of examining the pharynx, they are still found in instrument-cases. More recently, however, especially since the introduction of rhinoscopy, many different forms of spatulas have been devised by various authors, all of which are much better adapted to their purpose than the earlier forms, as they permit of the tongue

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[1] Galvanokaustik. Wien, 1871, S. 72.

being well depressed upon the floor of the mouth, without caus-
ing any interference with the rays of light which enter the latter.

Fig. No. 1 represents the various forms of tongue depressors
which have been found to be most practical for rhinoscopic pur-
poses ; 1, being the original form
of spatula, improved by being
curved like a bayonet ; 2, the
form of spatula recommended
by Türck ;[1] and 3, that of the
author.[2] In using the forms of
spatula represented in Figs. 2
and 3, it will be found necessary,
in order to press the tongue
downwards and forwards, to ele-
vate the handle of the instru-
ment and carry it away from the
patient. The instrument must
thus, as it were, be rotated about a fixed point, which is to be
considered as lying just above the incisor teeth, in order that the
portion of the spatula which lies upon the tongue may exert its
pressure in the desired direction. The instruments figured as 2
and 3 are so constructed that they may be held by the patient.

FIG. 1.
Tongue spatulas.
1. Bent in bayonet form. 2. According to Türck.
3. According to B. Fraenkel.

In order to avoid causing retching when using the spatula, it
is necessary to place it firmly, but without much pressure, upon
the tongue, to prevent its gliding backwards and forwards, and
to keep it away from those points which are liable to initiate
reflex acts of retching. These differ in different individuals,
but, as a rule, the palate and neighboring parts are especially
irritable.[3]

In the examination of the pharynx it is also necessary to pay
especial attention to the *method of illumination.* The rays of

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[1] Klinik der Krankheiten des Kehlkopfes. Wien, 1866, S. 104.

[2] Demonstrated in the Berlin Med. Society, the 27th of Feb., 1870. Berl. klin.
Wochenschrift, 1870, S. 221.

[3] It is self-evident that in all cases in which the same instrument is used upon several
patients, it should be carefully cleaned, to avoid the danger of conveying contagious
secretions. Instruments of metal may be readily disinfected by immersing them in
boiling-water.

light should have the same direction as the open mouth of the patient, and, when this is impracticable, the operator will be obliged to use a reflector, for the purpose of producing a suitable illumination of that cavity.

We cannot refrain, in this connection, from specially urging the importance of the use of the reflector for purposes of illumination. The writer himself regards this simple instrument as so useful that he always carries it with him in practice, and is thus never obliged to do without favorable illumination.

The pharynx, and especially its deeper parts, can be better viewed with the aid of a reflector than without, and its use is accompanied with the further advantage that the position of the patient need not be accommodated to the light, but that he can be examined in any position.

By daylight, for instance, there is no need to set a patient up, or to turn him round, even if he is lying with his head against the window. With artificial light, the value of the reflector is even more striking, and in fact one can hardly do without it. In its absence the lamp must be held between the examiner and the patient. In that case it is well to protect the eye of the examiner against the light, by some opaque shield, as in Helmholtz's simplest form of ophthalmoscope, which shield may be of pasteboard, or consist of the bowl of a spoon, the examiner looking past the light into the pharynx.

By this method, then, that part of the pharynx which serves the double purpose of a passage for food and air is rendered visible, and the examiner will find that, in accordance with this double purpose, its configuration, dependent upon the degree of contraction of the muscles situated within its walls, is very variable, and that the position of the velum, with its widely spreading arches, exercises an important influence in determining its general form. The latter, when in a state of rest, forms a dividing partition, or curtain, between the cavities of the mouth and pharynx, and represents a continuation of the bony palate which separates the nose from the mouth.

In the median line, which may be recognized by a pale, shallow depression, the velum terminates in the conical uvula, about eight-tenths of an inch in length, while laterally it divides into

two arched continuations. The anterior of these, the arcus glos-
so-palatinus, recedes laterally, and towards the tongue appears
as a sharp fold of mucous membrane, while above, towards the
uvula, it loses itself. The posterior, the arcus pharyngo-palati-
nus, reaches further towards the median line, and appears supe-
riorly as a sharply marked ridge, while inferiorly it merges into
the lateral wall of the pharynx. In this arch are located mus-
cles of the same name, the contraction of which affords a divid-
ing line between the mouth and the pharynx (isthmus pharyngo-
oralis), or between the pharynx and the nose (isthmus pharyngo-
nasalis). Between the arches extends on either side the inter-
stitium arcuarium, an irregular triangular space, increasing in
size from above downwards and from before backwards, and
containing, imbedded in its loose mucous membrane, the oval
tonsilla palatina, which is made up of an aggregation of folli-
cular glands. The tonsil may either lie on a level with that
of the mucous membrane, rise above it, or be deeply imbedded
in it, and always presents an irregular and fissured surface,
together with numerous small openings, leading into those
cavity-like depressions of the mucous membrane around which
the follicles are aggregated. The number of these openings is
usually in inverse ratio to their size.

Looking through the arches of the velum the posterior wall
of the pharynx may be seen, with its loosely stretched mucous
membrane thrown into small folds, and closely following the
curve of the vertebral column. The position of the velum will
determine the limit of inspection upwards, while upon the degree
of depression given to the tongue will depend the extent of the
view obtained downwards—the latter in favorable cases including
the free edge of the epiglottis, and occasionally the tips of the
arytenoid cartilages. The smooth surface of the mucous mem-
brane is here broken only by the plica pharyngo-epiglottica,
which runs obliquely from below upwards at an acute angle
towards the arcus pharyngo-palatinus, and in which is found
that portion of the stylo-pharyngeus muscle which goes to the
epiglottis.

The mucous membrane of the parts, provided with more or
less well-developed papillæ, and covered by pavement epithe-

lium, appears uniformly red. At certain points, especially on the posterior pharyngeal wall, ramifications of small vessels are distinctly seen, and parts—notably the arcus glosso-palatini and the uvula—are normally of a deeper red color than that of the surrounding membrane. Slight irregularities in the surface of the membrane are seen in all the parts which have been described, but occur especially in those near the arcus pharyngo-palatini and over the posterior pharyngeal wall. These little nodules, which vary much in form and number, are of the size of a millet seed, and are caused by the presence of follicular glands, either single or in clusters. The mucous membrane is always moist. The surgeon is only able by means of frequent inspections and careful observation to determine the normal appearances of the region described, not only as regards its general configuration, but also in respect to its color, its glands, and the amount of its moisture.

Inspection should inform us whether deviations are observable in the color, in the blood-supply, or in the degree of moisture. We may satisfy ourselves whether there are abnormal secretions, swellings, deposits, foreign bodies, ulcers, cicatrices, closures, etc. We should especially notice the lustre of the mucous membrane, the absence of which sometimes calls our attention to erosions ; and, finally, we should test the mobility of the velum, in order to do which we may cause the patient to phonate the vowel "a" [eh], for instance.

It not unfrequently happens that either the projecting arcus glosso-palatini or hypertrophied tonsils hide from view the posterior portions of the lateral walls of the pharynx, a locality in which syphilitic ulcerations in particular are frequently found. In such cases it is necessary either to press the arch of the palate outwards, during which procedure we are frequently aided by the retching of the patient, or to introduce a laryngeal mirror in such a manner that the hidden parts are reflected in it, an operative procedure which is so simple that it demands no further attention here.

The other difficulties which stand in the way of an examination of the pharynx are usually easily overcome. If the patient will not open his mouth willingly—not an unusual occurrence

with children—the head, with the mouth directed towards a suitable light, must be held by an assistant ; the arms fastened, and the nose held closed by the fingers until the necessary effort at inspiration causes the mouth to be opened. The spatula, which has been held in readiness, should then be quickly introduced, and when once it is behind the incisor teeth the physician is master of the situation, and may readily cause the patient to open the mouth widely by provoking retching. If during this act the contents of the stomach rise up into the mouth, or a profuse secretion of mucus collected in the pharynx obstruct the view, and interfere with the examination, the obstruction may either be removed by a sponge which has been made ready for the purpose, or the examiner must wait until the matters have been swallowed. By experience, together with perseverance, the surgeon will soon learn to embrace the right moment in which he may accomplish his purpose, and succeed in making as frequent examinations as are necessary, even in young children, and he will find that among the latter it will be only those of an unusually stubborn disposition who will continue to struggle against a procedure the unpleasantness of which they have already learned by experience.

Sachs [1] has proposed another method of dealing with these cases. He causes retching by passing a feather, sound, or some similar instrument backward between the mucous membrane of the cheek and the teeth, then in through the opening existing behind the molar teeth, thereby irritating the arches of the palate. Considering the energy with which many children and some insane adults resist the physician's efforts, as well as the unreasonable manner in which those belonging to them often act, this procedure, which rapidly attains its result, deserves consideration.

A further impediment to an examination of the pharynx lies in the idea of some patients that they cannot submit to the operation of depressing the tongue. Undoubtedly in some cases the pharynx is so irritable as to render the operation very unpleasant, in which case the patient should be told that efforts at retch-

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[1] Berliner klin. Wochenschrift, 1871, S. 603.

ing will rather assist than embarrass the surgeon; in most cases, however, the objection is only imaginary, and consists simply in an unwillingness to submit to the examination. A quiet explanation on the part of the examiner, and especially a rapid and well-conducted examination, will usually serve to relieve such a patient's fears. Occasionally a distaste for the instrument which the operator proposes to use, and the fear that disease may be communicated by means of it, are the reasons for the patient's objection. In such cases the patient's handkerchief may be placed between the spatula and the tongue, as I saw done by Lewin. Again, cases occasionally occur, especially among females, where an examination is not permitted for fear of revealing artificial teeth to the profane eye of the surgeon, and where this is the case diplomacy must support dexterity.

Finally, some caution must be observed in making a pharyngeal examination; physicians have been infected by the matters which are spit or coughed out of the mouth by the patient during the examination, and the examiner will therefore do well to keep his head as far as possible on one side, and out of range of the projected matters.

LARYNGOSCOPY.

Czermak, Der Kehlkopfspiegel und seine Verwerthung für Physiologie und Medicin, 2. Auflage. Leipzig, 1863.—*Türck*, Klinik der Krankheiten des Kehlkopfs. Wien, 1866.—*Semeleder*, Laryngoskopie. Wien, 1863.—*Tobold*, Laryngoskopie, 3. Auflage. Berlin, 1874.—*Störck*, Zur Laryngoskopie. Wien, 1859.—*The same*, Sammlung klinischer Vorträge, No. 36.—*v. Bruns*, Die Laryngoskopie. Tübingen, 1865.—*Voltolini*, Galvanokaustik, 2. Auflage. Wien, 1871.—*Morell Mackenzie*, Use of the Laryngoscope, 3d Ed. London, 1871.—*The same*, British Med. Journal, 1872, II., pp. 233, 259, 317.—*Gibb*, Diseases of the Throat and Windpipe. London, 1864.—*Prosper James*, Lessons of Laryngoscopy. London, 1873.—*Moura-Bourouillon*, Cours complet de laryngoscopie. Paris, 1861. —*Fauvel*, Du Laryngoscope au point de vue pratique. Paris, 1861.—*Fournié*, Étude pratique sur le laryngoscope. Paris, 1863.—*Habertsma*, De Keelspiegel. Leyden, 1864.—Compare *Merkel*, Die Leistungen auf dem Gebiete der Laryngoskopie; Schmidt's Jahrbücher, No. 108, p. 81; No. 113, p. 217; No. 119, p. 312; No. 122, p. 89; No. 133, p. 317; No. 134, p. 99.

By the term laryngoscopy is understood the art of viewing the interior of the larynx in the living human subject, and to

accomplish this, it is necessary, 1st, to illuminate the laryngeal cavity; 2d, to convey the picture of the parts obtained to the eye; and 3d, so to conduct the necessary manipulations as that they can be tolerated by the patient. It was only after all these conditions had been fulfilled that laryngoscopy could claim to rank as a method of examination suitable for general use. According to this view of the subject, Prof. Czermak, lately deceased at Leipzig, may undoubtedly be regarded as the discoverer of the art, for although many of his predecessors had endeavored to obtain a view of the interior of the larynx, and appear to have nearly attained their object, all failed of complete success because they were unable to fulfil, at least to a sufficient degree, one of the necessary conditions mentioned above. Czermak, however, not only overcame the difficulties which, up to his time, had been in the way of laryngoscopy, but also appears to have had a clear appreciation of its importance for diagnostic and therapeutic purposes, saying in the "Wiener medicinische Wochenschrift," No. 13, of the 27th of March, 1858, that he recommended this method of examination "most strongly to physicians, as suitable for the most general and widespread use."

Czermak's claim to priority has, however, been disputed; French authors in particular, even those who wrote prior to 1870, advance the assertion that the art of laryngoscopy was discovered before him. There is no question but that the discovery had been nearly reached before him. Certain investigators had already attempted to illuminate the cavities of the human body by means of artificial light, notably Bozzini,[1] at the beginning of the present century; Bennati, in 1832, experimenting with an instrument constructed for him by a mechanician, Selligue, who was himself a sufferer from laryngeal phthisis; and finally, in 1844, Avery,[2] of London. All these observers made use of tubes for the purpose of conducting the artificial light, and it can be readily seen, that aside from the difficulty and awkwardness of introducing such tubes, the tongue and epiglottis, being

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[1] Der Lichtleiter. Weimar, 1807, und Hufeland's Archiv der Heilkunde, Neue Folge, 17. Band.

[2] Diagram of the instrument in Mackenzie.

pushed backwards during the examination, must have presented an insurmountable obstacle to the success of the operation. Trousseau and Belloc, from whose writings the experiments of Bennati and Selligue became better known, also experimented with a similar instrument, and they not only doubt whether Bennati ever saw the larynx, but take pains to prove that it is impossible to see anything of the larynx excepting the epiglottis.[1]

Other predecessors of Czermak, among whom may be mentioned Levret, of Paris, in 1743 ; Senn, of Geneva, in 1827 ; Babington, of London, in 1829 ; Baumès, of Lyons, in 1838 ; and Liston, of London, in 1840, all of whom employed a small mirror fastened to a long handle, instead of the tube used by the other authors alluded to, also met with many difficulties in the practical application of the art, and their results were unsatisfactory.

Some of the mirrors described by these last-mentioned authors resemble very nearly those in present use, especially that of Babington, a drawing of which is given by Mackenzie, in his work above cited.   But the inventors did not understand, on the one hand, how to overcome the difficulty of obtaining an efficient illumination, and, on the other hand, their method of examination was so incomplete that they did not pass much beyond the epiglottis, and consequently only saw, at most, the upper and posterior parts of the larynx.

The same facts are true regarding the experiments of Warden, of Edinburgh (1844), who attempted to explore the laryngeal cavity by means of two prisms instead of a mirror.

The first experimenter who in reality fully explored the larynx in the living subject was a teacher of singing in London, named Garcia.   During a vacation spent in Paris, in September, 1854, he discovered the art of auto-laryngoscopy, and the following year communicated the results of his experiments and observations to the Royal Society of London, in a paper entitled "Physiological Observations on the Human Voice."   He used, for the purpose of examination, a small mirror fastened to a long handle, and illuminated the parts by means of either direct or

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[1] Phthisie laryngée.   Paris, 1837, p.177.

reflected sunlight. Notwithstanding the fact that Garcia demonstrated his method, not only upon himself, but also upon others, it found no general acceptation, chiefly because it was believed that an especial skilfulness and unusual insensibility of the pharynx were demanded upon the part of the patient, to permit of the introduction of the mirror—a fact which is readily explainable when it is stated that Garcia examined the larynx with the tongue lying upon the floor of the mouth, and during a deep inspiration, a position of the parts thereby resulting which prevented even his seeing the anterior portions of the vocal cords.

From what has already been stated it appears that, all other investigators having failed in effecting their purpose, the claims of Czermak to priority in the matter of the discovery of laryngoscopy cannot be controverted. Türck has, however, preferred his claim, with a much greater semblance of right. While physician-in-chief to the General Hospital in Vienna, during the summer of 1857, Türck examined, laryngoscopically, many patients in his wards, using for this purpose the direct rays of the sun, and a mirror of the same form as that which is in use at the present day. He also originated the method of examination which is now generally employed, viz., with a protruded tongue and uninterrupted respiration, and was undoubtedly the first observer who obtained a complete view of the interior of the larynx. He, however, appears either to have had no conception of the importance of his discoveries, or was unable to overcome the difficulties caused by a want of proper illumination ; otherwise, it is unexplainable why he, when so near success, should have allowed the renown of the discovery to pass to another. He states, to use his own words, that he discontinued his examinations during the winter of 1857–58, " on account of a scarcity of sunlight," and lent his mirrors to Czermak, professor of physiology at Pesth, who was at the time in Vienna, and had heard of Türck's experiments, now given up. As has already been stated, Czermak at once perceived the importance of the subject, and its practicability in nearly all cases, and did all that was possible by lecturing, writing, and demonstrations, to spread the knowledge of the art.

The dispute, therefore, as to the priority of the discovery begun by Türck, and the documentary proofs of which, sustaining their rival claims, are given in the works of both authors cited above, must be decided in favor of Czermak, whose name will be held in grateful remembrance by posterity, as it is by most of his contemporaries, as the discoverer of laryngoscopy. This controversy over the priority of the discovery begun by Türck, together with Czermak's labors, served to spread the fame of the art with astonishing celerity over the whole world. The long list of authors heading this chapter, which could easily be augmented, affords a striking illustration of this fact. Many others, also, have done much to develop and perfect the method of examination. Among these stand Schrötter and Schnitzler, in Vienna ; Gerhardt, in Würtzburg ; Ziemssen, in Erlangen [now in Munich] ; Lewin, Traube, and Waldenburg, in Berlin ; and Rauchfuss, in Petersburg.
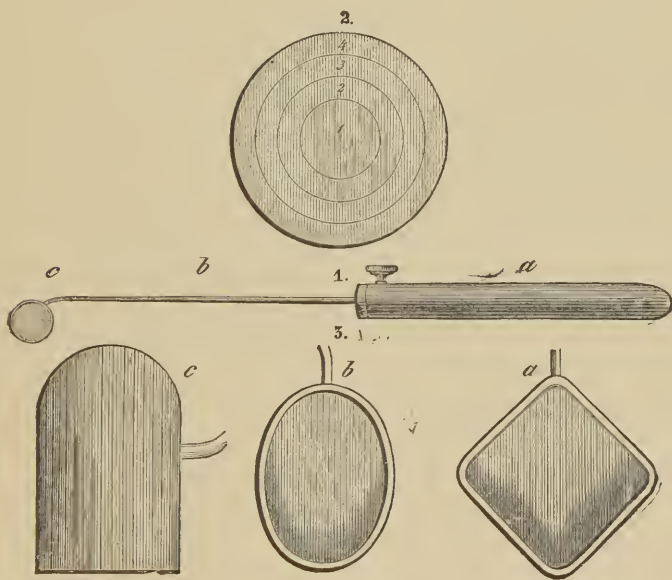
Fig. 2.

1. Laryngoscopic mirror. *a*, Handle ; *b*, stem ; *c*, mirror. 2. Sizes of the round mirrors in ordinary use. 3. Other forms of mirrors : *a*, quadrilateral, with rounded corners (Czermak) ; *b*, oval ; *c*, according to Bruns.

The *means requisite for the performance of laryngoscopy,* are : 1, a laryngeal mirror, and 2, suitable illumination.

The mirror is preferably round, from four-tenths of an inch to one and a quarter inch in diameter, and should be made of good white glass, thoroughly polished and well silvered. This is strongly fastened to a rod at an angle of about 120°, the rod terminating in a suitable handle. Instead of this round form of mirror, others have been devised, the forms of which, being shown in Fig. 2, will need no description. The costly steel mirrors formerly employed are no longer used since the introduction of good glass ones. The intermediate sizes of the latter, Nos. 2 and 3, will be found most convenient for general use. The mirror represented at 3 *c*, has this disadvantage, that it must be used either by the right hand, as in the cut, or by the left, owing to the rods being fixed at the side of the glass, and a change of hands requires, therefore, a change of mirrors.

In purchasing a mirror the following points demand attention: 1. The glass should be white, so that when held over a piece of white paper, the latter shall be mirrored as white, and not blue or green. 2. The metal fastening, made of the best German silver, should not encroach upon its reflecting surface more than 1 mm. 3. The thickness of the mirror should be the least possible, for the thinner the mirror the less space it will occupy, and so much less will the soft palate have to be pressed backwards during the examination. 4. The rod must be of sufficient strength not to bend during use, but, at the same time, should be sufficiently flexible to allow of slight modifications in its form without breaking, and it must be firmly fastened to the mirror, so that there may be no danger of the latter becoming loosened and falling into the larynx during the examination. 5. The handle should be adapted to the hand of the operator who uses it. 6. The rod or stem should be at least three and a quarter inches long ; the handle and rod together, seven or eight inches. It is a matter of indifference whether the rod be fastened on the handle permanently, or temporarily by means of a screw, so that it may be removed. The latter arrangement is preferable when it is desired to have several mirrors fit into one handle, viz., in a transportable instrument-case.

In speaking of the subject of *laryngoscopic illumination*,[1] it will be desirable first to establish the physical conditions which regulate its successful performance. A plain laryngeal mirror (Fig. 3) placed in the pharynx reflects the rays of light which enter into the mouth of the patient in such a manner that they

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[1] Compare *Weil*, Gewinnung vergrösserter Kehlkopfspiegelbilder. Heidelberg, 1872 ; *B. Fränkel* and *J. Hirschberg*, Deutsches Archiv für klinische Medicin, XII. Band.

are thrown into the larynx, and the examiner sees the latter, in all its parts, reflected back to his eye in the same manner and along the same path by which the light entered. From this fact, therefore, we derive the following conditions for the illumination of the laryngeal parts :

1. When we desire to view the most brilliantly illuminated part of the larynx in the mirror, it is necessary to place the eye as near as possible in the centre of the cone of light which enters the mouth of the patient.

2. It is necessary to use an intense light, on account of the great loss that the light suffers from absorption and refraction during its course, and because, owing to the relatively narrow opening which the mouth of the patient presents, only a small part of the light which enters it is thrown upon the larynx and thus utilized. The less intense the illumination, therefore, the larger must be the laryngeal mirror, in order to obtain a distinct picture of the larynx.

3. In using the various forms of illuminating apparatus, which do not produce a uniform clearness or brilliancy of illumination at all distances, because they do not throw parallel rays of light, it is of great importance to cause their radiant point to fall upon that part which the examiner wishes especially to illuminate and observe, and for the larynx this point may be considered as lying upon a level with the glottis. In adults, therefore, of medium size, it will be three inches below the laryngeal mirror which is held in position in the pharynx, and as this latter lies three inches within the mouth of the patient, it will be necessary in such cases to throw the radiant point six inches within the mouth of the patient. In women the distance which the rays of light will have to travel to reach the glottis from the opening of the mouth will be from four to five inches, and in children from three to four inches.

It will be readily understood that these rules cannot be observed with mathematical accuracy, nor be closely carried out in all cases. All illuminating apparatuses afford circles of dispersion sufficiently distinct for our purposes in the vicinity of their radiant point, perhaps one inch above or below it, and the plane of the glottis may, therefore, be considered as the correct

one for the whole larynx ; slight variations from the above rule being dismissed as unimportant.

The only point, then, which demands careful attention is, that the part which is to be examined shall be more brightly illuminated, and if the bifurcation of the trachea, for instance, is to be inspected, it is necessary to remember that the trachea is five or six inches long, and that the light must be adapted accordingly, otherwise the success of the examination will be materially interfered with.

It is not desirable during the examination to place the eye nearer than five inches to the mouth of the patient, for apart from other inconveniences this amount of intermediate space between patient and physician is necessary in order to afford room for the hands of the operator to carry on the manipulations with the laryngeal mirror and other instruments.

The larynx lies eleven inches, the bifurcation from sixteen to seventeen inches, from the examiner's eye. To emmetropic persons these distances admit of the most distinct views, but hypermetropic and presbyopic subjects will have to make use of compensating convex glasses in order to make these same distances suit, or they may bring the glottis within their range of vision by increasing the distance of their eye from the patient's mouth. Myopia of less than one-tenth requires the aid of negative glasses, while that of from one-tenth to one-seventeenth does not need them, except to view the bifurcation and the trachea.

Thus all that laryngoscopy requires of the science of optics may be stated in the following proposition : *It is necessary to produce as intense an illumination of the throat as possible, which in the adult shall be brightest at a distance of six inches from and within the patient's mouth, and which will at the same time permit of the observer's eye taking, as nearly as possible, a central position in the entering cone of light, at a point about five inches from the mouth.* The different methods of illumination may now be considered in the following order :

A. ARTIFICIAL ILLUMINATION.

This is indispensable, for by means of it the operator is ren-

dered entirely independent of both weather and time of day. Those methods will first be described which may be employed with every artificial source of light. It is possible to examine the larynx by means of a simple flame, covered towards the observer's eye, and placed as near the patient's mouth as possible without obstructing the view; but this method, which is the simplest form of illumination, presents so many disadvantages that it is seldom employed except in cases of necessity. Consequently other optic aids are generally resorted to. Among these the first to demand attention is

I. *Illumination by Means of Concave Mirrors.*

And first, attention is called to the following formula :

$$\text{1st.} \quad \frac{1}{F} = \frac{1}{A} + \frac{1}{A'}$$

in which F denotes the focal distance of the mirror (half the radius of the curve), A the distance of the flame from the mirror, and A' the distance of the image from the mirror.

$$\text{2d.} \quad g : g' = e : e'$$

in which g = the size of the object (in this case of the flame), g' = the size of the image, e = the distance of the flame, and e' = the distance of the image from the mirror.

In order to fulfil the above requirements which laryngoscopy makes upon the science of optics, concave mirrors, perforated or transparent in the centre, with a diameter of from three to four inches, and a focal distance of from six to seven inches, are the best. They are perforated or transparent in the centre, in order that the eye, when looking through them, may be brought within the axis of the cone of light which is thrown into the patient's mouth. If the silver foil alone has been removed, it is true that the observer's eye will be sufficiently protected ; but care will then be necessary, lest a coating of dust should render the instrument useless for purposes of accurate observation. If the perforation be made directly through the glass, it should be either round or oval, and its diameter should not exceed about a quarter of an inch ; this will render it sufficiently large for the eye, and will not unnecessarily diminish the reflecting surface of the mirror.

The concave mirror is used in laryngoscopy for the purpose of throwing an image of the flame—that is, the optic expression of the union of all the rays of light which it reflects—into the patient's larynx. The observer's eye being placed close behind the mirror, the image of the flame, according to the above calculation, would be found at a distance of eleven inches from the mirror (five inches before the mouth, and six inches within it). In women and children a deviation from this measurement will be caused by the lesser distance of the glottis from the opening of the mouth; this is, however, easily corrected by removing the eye and mirror the given distance from the mouth.

The intensity of the illumination may be increased by availing ourselves of the conjugate focus, and as this lies on the other side of the principal focus, but within double the focal distance, mirrors of from five and a half to ten inches focus may be used, as deemed desirable. Those of a focal distance of from six to seven inches will, however, be found preferable, as they give the greatest intensity, at the same time relatively diminishing the size of the image least; on the other hand, to examine the bifurcation, a mirror with a focal distance of about nine inches would, for the same reasons, be needed.

After what has been said, it will be readily seen that far-sighted persons, not desiring to use correcting glasses, may readily select a mirror corresponding to their sight.

The focal distance of a concave mirror is measured: 1, Directly, by ascertaining the distance of the solar focus; 2, Approximatively, by diffused daylight, by ascertaining the distance of the image of a remote object; and 3, With artificial illumination, by measuring the distance of the flame (A) and of its image A′, and inserting their values in the above-mentioned equation, of which the focal distance, F, will then be the unknown quantity. In all cases the measurements must be taken from the centre of the mirror, and at right angles to its tangent. The importance of thus ascertaining the exact focal distance of a mirror, as regards its illuminating power, renders it advisable that the surgeon should make the above measurements himself, and not rely upon the instrument-maker.

For laryngoscopic examination, it is not necessary that the mirror be made of metal; a good mirror of glass, covered with Liebig's silver foil, answering all purposes.

The larger the diameter of the mirror the greater will be the intensity of the image; but this diameter cannot be increased to

above four inches, for apart from the increased cost of such a large mirror, the surgeon is placed at the disadvantage of not being able to use both eyes in his examination ; the diameter of the mirror must, therefore, necessarily be less than double the distance between the observer's eyes.

To render this mirror a convenient apparatus for laryngoscopic illumination, it is framed and attached to a stem by means of a joint which is movable in all directions—preferably a single or double ball-and-socket joint. Upon these points all laryngoscopists are agreed, but great differences of opinion exist as to what the stem should be attached to. All sorts of methods have been recommended. It does not do to hold the handle in one's hand, because in the majority of examinations both hands are otherwise employed, and it will therefore probably be found best to attach it to the observer's head. This may be done by means of the Semeleder spectacle-frame, or the recently improved forehead-band known as Cramer's (Fig. 3). In the former apparatus care must be taken that the handle which joins the mirror to the spectacle-frame is large enough to permit of the mirror's passing freely in front of the observer's nose ; in the latter apparatus those
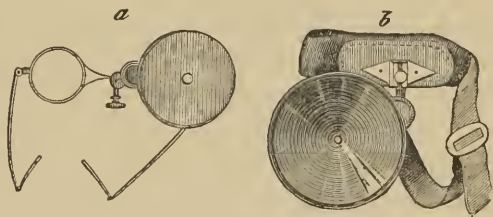
Fig. 3.
a, Semeleder's spectacle-frame ; b, Cramer's forehead-band.

forms of attachment will be found preferable which admit of a second point of support for the mirror being taken upon the bridge of the nose. Czermak's original mirror was attached to a mouth-piece made of orris root, which was held between the teeth ; but this method has now been entirely laid aside, although, perhaps, not deservedly so, inasmuch as to physicians with good teeth it presents the advantage of causing no disarrangement of the *coiffure*.

Whether the mirror should be placed before the right or the left eye, upon the forehead, or over the nose, depends entirely upon the habit of the observer. It is generally, however, worn before the left eye, for the reason that the right hand is the one

usually employed for instrumental manipulations, and no light is therefore cut off by it from the mirror over the eye upon the opposite side.

Instead of being fastened to the observer's head, the mirror may also be attached, by means of movable arms, to lamps or to certain fixed apparatuses. These latter, in turn, are fastened either to the case in which they are kept (Czermak), or, by means of an arrangement similar to the *sewing-bird* (Waldenburg, Bose), are screwed fast to tables, chairs, or beds, or they may be supported by a heavy base made especially for this purpose. Arrangements of these latter kinds are more convenient, permitting of freer movements of the head, and requiring less practice for their successful use than the former. But away from the consulting-room, and when attempting to examine bed-ridden patients, the physician will often meet with unexpected difficulties if he be accustomed to their use alone ; while if he use the former, he will find them available everywhere and in all positions which the patient may assume. I have actually found myself in a house, furnished most luxuriously, where there was no piece of furniture upon which the screw apparatus mentioned above could be fastened. For these reasons, then, forehead-bands, mouth-pieces, and spectacle-frames are to be preferred to other means of attachment, when used outside of the consulting-room, and in any case, every form of fixed apparatus, to be practicable, must be so arranged as to allow of sufficient room for the free exercise of the operator's hands.

By whatever method, however, the mirror may be placed before the eye, it is always necessary that the illuminating flame should have a fixed and exact position. Its proper distance from the concave mirror (A) can easily be determined by means of the above-mentioned formula, the distance of the image of the flame equalling eleven inches, and the focal distance of the mirror being known. The calculation affords the following results :

The focal distance of the mirror (F) being	The distance of the flame (A) will be	
5.5 inches..................	11 inches	
6. "	13.2 "	
6.5 "	15.9 "	$A' = 11.$
7. "	19.2 "	
8. "	29.3 "	

Fig. 4.

Illustrating the course taken by the rays of light projected by means of a concave mirror.

a, Flame; *b*, concave mirror; *c*, eye; *d*, image of the flame; *e*, laryngeal mirror; *f*, glottis, with the image of the flame reflected upon it by means of the laryngeal mirror.

The light should be placed upon the right or upon the left side of the patient, according as the concave mirror covers the right or left eye of the observer; thus it usually stands on the left of the latter, and on the right of the patient sitting opposite to him. The light should be brought as near as possible to the patient's head, lest the angles of incidence and refraction becoming too great, a portion of the light should be lost; and it should, further, be placed above the axis of vision of the observer, in order that his hands may intercept none of its rays.

These precautionary measures having been carefully observed, no difficulty will be found in obtaining, by means of the simple concave mirror, an illumination amply sufficient for laryngoscopic purposes in all cases, and the advantages which result from such examinations are valuable enough to richly repay the observer for the care and diligent practice which he may expend in acquiring the use of the instruments. Having learned the use of this method of illuminating the larynx, all other methods are readily acquired. A diagram illustrating the subject is given in Fig. 4.

We cannot leave the question of illumination by concave mirrors without remarking that they have also, by some authors, been placed behind the flame, to serve as reflectors, though this is not a matter of much practical value.

II. *Illumination by Means of Lenses*.

The image of a flame obtained by means of a convex lens—one with a focal distance of from six to seven inches being preferred—may be appropriately used for purposes of laryngoscopic illumination. The lens should be placed between the patient's mouth and the flame, being at a distance of about five inches from the former. The distance of the flame from the mouth should be governed by the same measurements as when the concave mirror is used, it being remembered that the image of the flame rises if the lamp is depressed, and *vice versa*. The observer's eye is now to be placed as near as possible to the lens; but, as can readily be seen, it cannot be brought within the axis of the cone of light which enters the patient's mouth without

obstructing the light. In this respect, therefore, illumination by concave mirrors has a decided advantage over that produced by means of lenses. The defect which has been alluded to can be overcome only by diverting the light which proceeds from the lens, by causing it to fall, at the proper angle, upon a perforated plane mirror, so arranged as to permit of the eye being placed behind it. An apparatus is thus constructed which may be used for laryngoscopic examinations, but which offers no advantages over the simple concave mirror.

Many authors have employed condensing lenses, not so much with the idea of procuring an image of the flame as to obtain other important results in the matter of illuminating the larynx, availing themselves only of the bright space behind the lens, which exists for the reason that the rays of light are less divergent on leaving than on entering it.

In the majority of cases the lens is then fastened to the lamp. (Krishaber, Fig. 5; Moura-Bourouillon.)

In Fig. 6 we give an illustration of the way in which Mackenzie has applied this method of the employment of a lens to a gas lamp, movable in all directions. Mention may also be made of the shoemaker's lenses (lens-shaped bottles filled with some clear
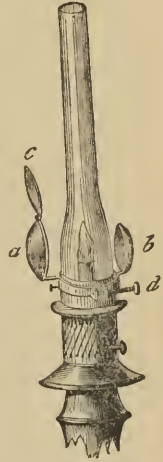
FIG. 5.
Illuminating apparatus of Krishaber.

a, Lens; *b*, reflector; *c*, supplementary mirror; *d*, ring provided with a spring catch, by means of which the apparatus can be attached to any form of lamp.
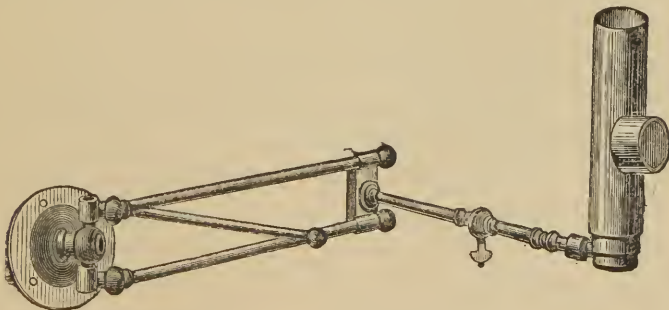
FIG. 6
Mackenzie's "Rack-movement Lamp."

fluid), which have no definite focus, and which may be sus-

pended from a suitable framework in such manner that they can be raised and lowered as required. Many laryngoscopists, who have become accustomed to their use, still employ them. Störk is among this number. In case of need ordinary decanters filled with water may be substituted in their place.

By means of any of the many forms of apparatus alluded to or described, a laryngoscopic examination can be made, but none surpass, and certainly none excel in simplicity, the concave mirror.

III. *Combination of Concave Mirrors and Lenses.*

The combination of a condensing lens and a concave mirror, first devised and applied by Lewin as an illuminating apparatus, is constructed for the purpose of producing an image of the flame equally intense with, but larger than, the small, inverted image obtained by means of a concave mirror alone. In this case the value of the optic constants will vary according to the relative position of the lens to the flame. In the consideration of the subject which follows, the flame will be considered as a luminous point, and any deviations caused by its varying dimensions will be disregarded, as they are easily corrected in practice.

1. If the flame stands in the focus of the lens, the rays of light will leave the latter parallel to each other, and may be concentrated by means of a concave mirror, with a focal distance of eleven inches, so as to give an image at a distance of eleven inches.

2. If the flame be further distant than the focus from the lens, the rays will be refracted convergently, but may be concentrated by means of a concave mirror of more than eleven inches focal distance, so as to form the image at the desired distance.

3. If the flame be nearer to the lens than the focal distance, there will be produced behind the lens a virtual image of the flame, of which a reversed and smaller image, precisely similar to the one produced by the flame without a lens, may be produced by means of a mirror with a focal distance of from six to seven inches. Just where the flame should stand with a simple mirror must lie the virtual image, and its exact position may be

determined by means of formula 1 (p. 19), which also holds good for lenses.

In all these cases a lens with a focal distance of from four to five inches will answer the purpose. According to formula 2, (p. 19), the size of the image of the flame increases as the lens approaches the flame, and therefore nothing is to be gained in regard to the intensity of the single points.

Lenses with a focal distance of from four to five inches are easily prepared, and present smaller spherical aberrations than those of a greater curve and shorter focal distance. The size of the lens must hold a definite proportion to that of the mirror, otherwise light is lost, and therefore in the first of the above-mentioned cases the lens must be just as large, in the second larger, and in the third smaller than the mirror.

According to photometric measurements, obtained by myself and confirmed by the mathematical calculations of Hirschberg, these points appear to deserve more attention than has hitherto been paid to them. By a proper regard for the principles involved, a number of different illuminating apparatuses may be constructed, not to mention the fact that the light of a lamp, concentrated by means of a lens attached thereto, or by means of shoemaker's lenses (p. 25), may be utilized by the aid of a concave mirror worn on the examiner's head. These apparatuses must be so arranged that they can be easily attached to any lamp, and they must present no hindrance to the free movements of the observer's hands; they must also not interfere with the patient, and should be so constructed that they may be easily placed in a position which will correspond to the patient's height, without our being obliged to detach them from the lamp. In the larger forms of apparatuses the lamp is fastened to a stand with an upright rod, upon which its position may be changed at will; and finally, all the forms of illuminating apparatuses just described are designed to be placed on the left of the observer.

But, whatever external appliances may be used, we shall be obliged to conform to one of the systems given above, in the selection of the constant terms for our optic equation. I have given the preference to the method described in proposition

No. 1, as it seemed to me the simplest, and as it readily admits of an examination of the trachea down to the bifurcation, by simply carrying the lens nearer to the flame (Figs. 7, 8).
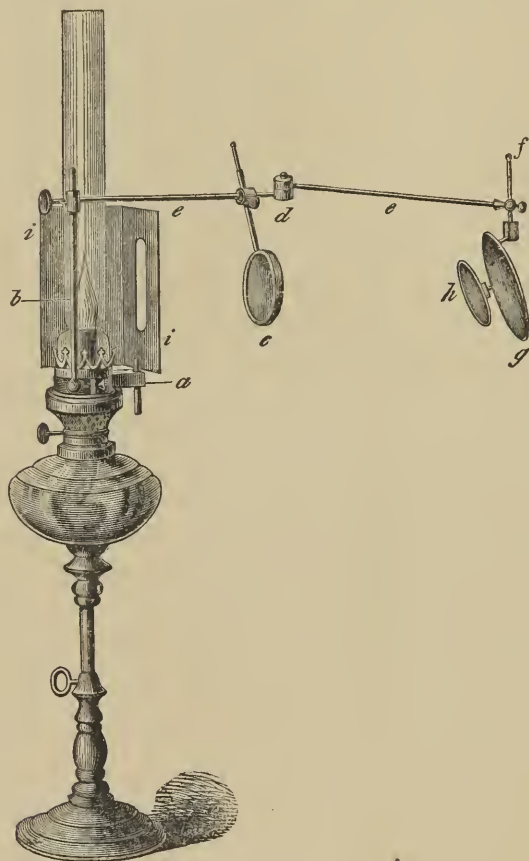
FIG. 7.

B. Fraenkel's illuminating apparatus (attachable to any form of lamp).

a, A vice, which holds *b*, the bar; *c*, lens, attached by means of a sliding clamp, *d*, to the arm, *e*; *f*, screw-heads, to prevent the rods from sliding through; *g*, reflecting mirror; *h*, supplementary mirror; *i*, shade.

Aside from producing the image of a flame, the combination of mirror and lens has been used to produce what is called a uniformly light circle. This is formed at a certain distance from the focal point, as a tranverse section of the circles of dispersion of the same, in which the contour of the flame is no longer perceptible; and a beautiful view of it may be had if the rays, after a strong convergent refraction by means of the lens, are reflected

Fig. 8.

Fraenkel's large illuminating apparatus, arranged upon a standard.
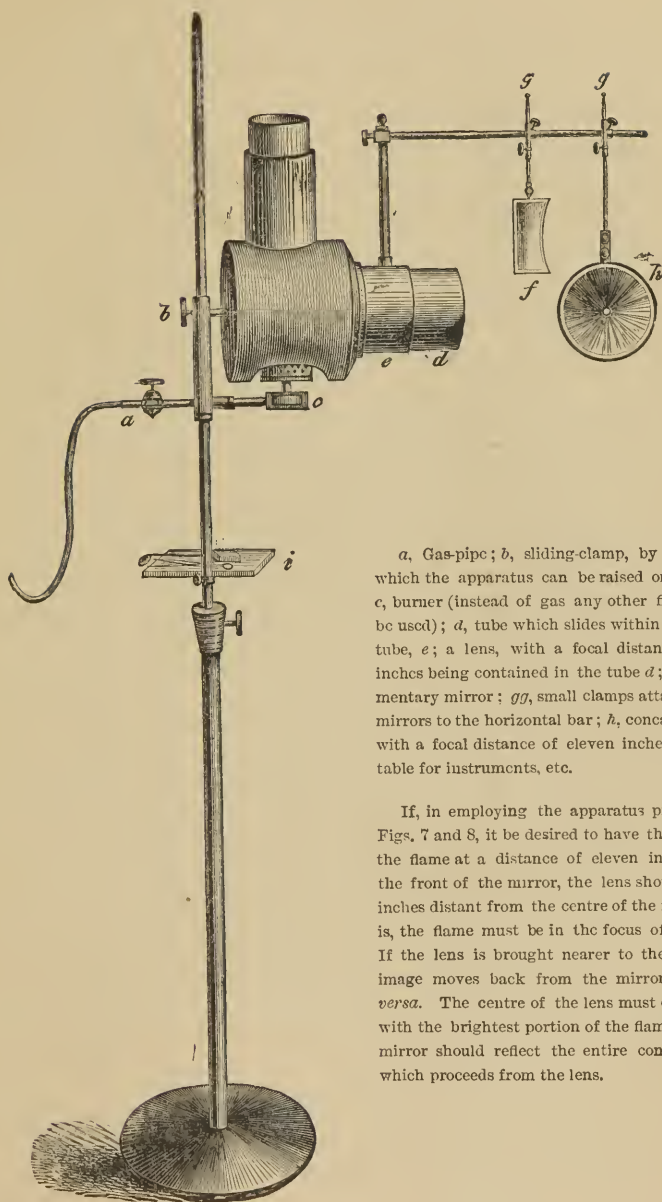
a, Gas-pipe; *b*, sliding-clamp, by means of which the apparatus can be raised or lowered; *c*, burner (instead of gas any other flame may be used); *d*, tube which slides within the larger tube, *e*; a lens, with a focal distance of five inches being contained in the tube *d*; *f*, supplementary mirror; *gg*, small clamps attaching the mirrors to the horizontal bar; *h*, concave mirror with a focal distance of eleven inches; *i*, small table for instruments, etc.

If, in employing the apparatus pictured in Figs. 7 and 8, it be desired to have the image of the flame at a distance of eleven inches from the front of the mirror, the lens should be five inches distant from the centre of the flame, that is, the flame must be in the focus of the lens. If the lens is brought nearer to the flame its image moves back from the mirror, and *vice versa*. The centre of the lens must correspond with the brightest portion of the flame, and the mirror should reflect the entire cone of light which proceeds from the lens.

by a mirror with a shorter focal distance (from four to seven inches). Such a circle is, however, less intense than the image of the flame, and for practical purposes has no advantage over it, although it presents a pretty and brilliant appearance when outside of the larynx and thrown upon a white surface. It is neither necessary nor desirable to employ more than one lens for an illuminating apparatus of this description, unless two lenses placed closely together are used so as to admit of a lesser curvature for each lens. In all other respects a single lens answers every purpose.

The extended use of Tobold's illuminating apparatus is not due to his system of using three lenses, but to other practical points which the instrument presents. Indeed, as has been proved by Weil,[1] it can be rendered more efficient by the removal of one or two of its lenses.[2]

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[1] Deutsches Archiv für klinische Med., 10. Bd., p. 584.

[2] Burow, sen., has undertaken to defend the system of three lenses (Deutsche Zeitschrift für Chirurgie, II., 438; Berliner klinische Wochenschrift, 1873, No. 48); and in consequence of a reply to his remarks, published in No. 50 of the Berliner klinische Wochenschrift, 1873, I was violently attacked by Burow in Nos. 9 and 13 of the Deutsche Klinik for 1874. The death of the author having occurred in the meantime, I was prevented from defending myself in the same paper, but may now state that Burow has not been able to convince me that no substantial advantages are lost by substituting the system of three lenses for that of a single lens. It has never been denied that by means of the application of three lenses an image of the flame could be produced at a distance of eleven inches, but this image is less intense than the one produced by a single lens, and presents no special advantages over it. I had been experimenting with Burow's optic constants, calculated for his system of three lenses, so as to *apply them*, if possible, to an apparatus with a single lens, by placing the latter where Burow places the first of his three. In consequence, Burow remarks that in this case, on account of a greater divergence of the rays, much light is lost if the same reflector be used. In this otherwise just remark, he overlooks the fact that the lost rays of light are compensated for by the relative smallness of the image of the flame. It is, moreover, possible, *without altering in the least degree the course of the rays of light*, to change his apparatus of three lenses into one with a single lens, by taking away the first two and placing the *flame* where Burow, by means of two distant lenses, throws the *image* of the flame.

In spite of all the well-grounded objections raised against this system of three lenses, Tobold still retains it unchanged in the latest edition of his Laryngoskopie (l. c., p. 22), and, as a defence, refers simply to the erroneous representations of Burow. This is all the more unaccountable as Burow himself declares that Tobold's optic constants, in which the rays of light leave the first lens divergent, or at most parallel, while on leaving the last they are convergent, are " useless " (Deutsche Klinik, No. 9, p. 71).

In case of necessity any flame may be used for the purposes of illumination. A choice, however, being offered, the round burner is preferable, on account of the steady light which it gives. The image of its flame will show brighter streaks at both sides, owing to the fact that more luminous points are represented here than in the centre of the flame. Sections of the flame, or a close inspection of the burner, will show this.

Whether oil, petroleum, or gas be used as fuel for the flame will depend upon which is most conveniently obtained. Gas furnishes the brightest, and oil the most agreeable light. Lamps have lately been constructed in London on the principle of Silber's patent, with a new method of supplying the air, which give a light of great brilliancy; their expensiveness, however, presents a barrier to their extended use.

With a laudable desire to increase the intensity of the light used for laryngoscopic purposes, some authors have abandoned the ordinary means of illumination, and employed either electric or calcium lights, or supply the common flame with a current of pure oxygen.

I have had no personal experience with these latter methods of illumination, having got along thus far without them. They are, as a rule, unavailable, on account of their expensiveness, and not absolutely necessary in general practice.

I know, however, that the gentleman, whose name as editor adorns the title-page of this Cyclopædia, prefers to the present day the method of illumination arranged by him with a Duboscq's lamp.

Fig. 9 gives a representation of his apparatus, which is fully described in Vol. IV. of the Deutsches Archiv. The positions necessary to correspond to the patient's height are obtained by elevating or lowering both the table of the apparatus and the seat of the chair, which are movable.

It will be found to the operator's advantage, when employing artificial illumination for the purposes of laryngoscopy, not to place the lamp in the brightest daylight, and decidedly not within the direct rays of the sun, lest his eye should be confused by the interfering side-light.

There is no doubt but that artificial illumination is most prac-

tical when obtained in a dark room; but with a good apparatus, not only laryngoscopic examinations, but intra-laryngeal operations also may be performed in a room which is either not at all, or but slightly darkened, and the so-called " laryngoscopic cabinets," that is, dark rooms especially arranged for the purpose, are therefore not requisite, even for a purist in laryngoscopic matters. A shade may, with advantage, be so attached to the illuminating apparatus, that only the homocentric light is permitted to enter the mouth of the patient; but the intensity of the light will be unnecessarily lessened, if, after the method of v. Bruns, the opening in the shade is made so small that only one point of the flame is available.
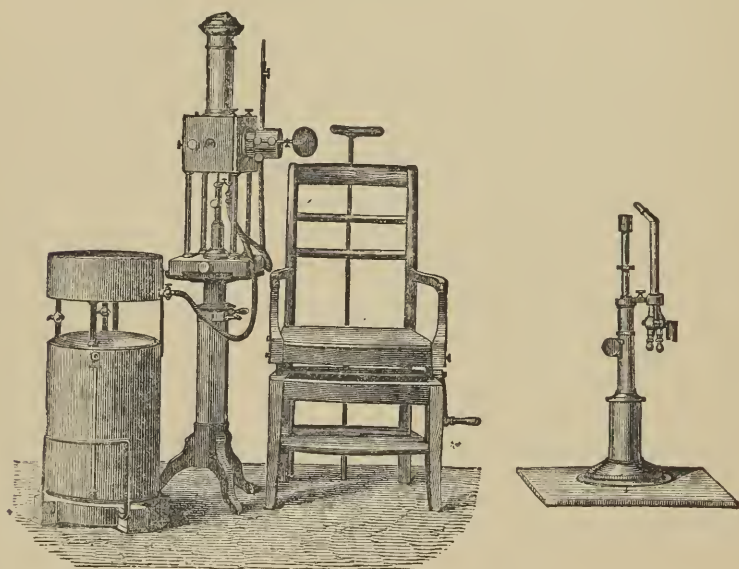
FIG. 9.
Von Ziemssn's oxy-hydrogen illuminating apparatus. The chair and table can be adjusted to different heights.

In making a selection from the above described forms of apparatus for artificial illumination, it must be remembered that in case of necessity any one of them may be used for laryngoscopic purposes, and that it is more important to be well practised in, and to understand fully the use of, some one form of apparatus, than to believe in any one method, as the only correct one.

This being premised, we would, without advising against the use of other forms of apparatus, suggest the following as the most practical :

1. A suitable reflecting mirror, attached to a forehead-band, spectacle-frame, or a mouth-piece. This apparatus is amply sufficient for all examinations, is easily transported, and its use should be thoroughly understood by every physician.

2. For hospitals, specialists, teachers of laryngoscopy, operators, etc., a large, well-arranged illuminating apparatus, similar in its construction to those represented in Figs. 8 and 9.

3. For the offices of physicians, a smaller apparatus, such as the one shown in Fig. 7, or a simple mirror attached to a stand. And finally,

4. A flame placed directly in front of the patient's mouth (p. 19), or a bottle filled with water, on the principle of the shoemaker's ball or lens, may be used in cases of necessity.

B. THE USE OF DAYLIGHT.

a. *Diffused Daylight.*

Diffused daylight may also be concentrated by means of a concave mirror, and, as it consists of parallel rays, such a mirror should have a focal distance of from ten to eleven inches. The arrangement of the reflector to an illuminating apparatus in this case is the same as that of the apparatus for artificial illumination already described ; but, in order to produce a sufficiently bright illumination, without using too large a laryngeal mirror, it will be necessary to obtain the daylight as homocentric as possible, the examination being made in a partially darkened room. These conditions are, according to Wintrich, accomplished by darkening the windows, and allowing the light to enter through an opening one foot square; but similar conditions may usually be readily found, without previous arrangement, in basements, or in back rooms looking out upon narrow courts. The physician will therefore usually discover in every house some one room already adapted to his purpose, or easily made so by partially darkening the windows. For similar reasons the examiner will,

in a room not previously darkened, take his position nearer to the wall opposite to the window, than to the latter.

The application of daylight being undoubtedly the simplest method of illumination, and one which does not heat the room, the physician will do well to acquaint himself with its use. In darkened rooms the pictures of the larynx produced by it are very beautiful, and, contrary to those obtained by means of artificial light, represent the natural color of the parts. It cannot be denied, however, that for the purposes of fine and accurate diagnosis, to be made in a limited amount of space for inspection, artificial illumination is preferable.

b. *Sunlight.*

Illumination by means of sunlight is preferable to all other kinds, as far as regards the distinctness of the images produced.

If sunlight be employed, the patient (1) should be placed facing the window, while the examiner sits with his back turned toward it; the light entering upon his right side and falling into the patient's mouth, and upon the small mirror introduced into the pharynx. To protect his eyes from the dazzling light, the patient may either close them, bring them within the shadow of the window-sash, or cover them with a shade. This method of examination was the one followed by Garcia and Türck, and is the simplest of all, but its disadvantages are, that the physician and patient are constantly exposed to the hot rays of the sun, and are obliged, besides, to change their relative positions, according to its varying altitude; hence, if the latter be great, considerable inconvenience will be experienced during the examination.

It is therefore better, in such cases (2), to reflect the rays of the sun by means of a mirror, and this may be done by seating the patient with his back to the window, and throwing the light into his mouth by means of a plane or concave mirror placed in front of the examiner's eye. With a concave mirror, however, the examiner must avoid throwing the exact focus into the larynx, said focus of the sunlight only blinding the eye, and

making it impossible to see anything of the larynx unless smoked glasses be used. The vanishing circles of the focus, those which lie behind and before it are, therefore, to be utilized, instead of the actual focus itself.

In this method of examination also, both physician and patient are necessarily exposed to the heat of the sun, and the former will find it difficult to prevent his eye from becoming dazzled by the light.

These inconveniences may be avoided if a heliostat is employed. This instrument placed before the window, or upon the window-seat, will throw the rays of light into the room, and directly into the patient's mouth. The patient may then be seated in the shadow of a window shutter, or of the wall, the examiner in this case being so seated as to have the reflected light upon his right side.

In order not to be obliged to place the patient in a position facing the entering rays, as we must do in the direct application of the reflected light, but rather to adapt the light to the position of the patient, it is desirable to reflect it a second time by means of a plane or concave mirror placed before the eye of the examiner. This method renders the use of sunlight very convenient. Unfortunately, however, heliostats are expensive instruments, and most physicians will, therefore, have to content themselves with the so-called hand heliostat, that is, a small mirror attached to a stand, and movable in all directions. In sick rooms, into which the sun shines, we may produce a very brilliant illumination by means of an ordinary toilet mirror, either placed or held in the sun's rays. In either of the latter cases the movements effected by the clock-work of the heliostat must be imitated by the movements of the observer's hand, and he will therefore be obliged to adapt the position of the mirror to the changing altitude of the sun, so as to direct the reflected rays in a manner conformable to his purpose. The sun, however, does not move so quickly but that the observer has time to make an examination, or even to perform an operation, without being obliged to correct the position of his mirror. The chief drawbacks to the use of the sun, which undoubtedly is the best source of light for laryngoscopic purposes, is not to be

found in these difficulties, but in the fact that it is not available at all hours, and may be obscured by any passing cloud.

After what has been said in the foregoing pages, it is hoped that the physician will have no difficulty in understanding the theory of artificial illumination, and will be able, not only to select a suitable apparatus for his purpose, and make its application practical, but, what is of much greater importance, will be able, under all circumstances, and at all times, to secure an illumination sufficient for a thorough laryngoscopic examination.

Performance of Laryngoscopy.

The performance of the manipulations necessary to obtain a view of the larynx requires practice and some skill, and although it may be an open question whether the performance of intra-laryngeal operations should not be left to the specialist, it cannot be disputed that every physician should at least be able to practise this most important method of examination so far as to enable him, in all cases, to arrive at a diagnosis.   Less practice is required to learn laryngoscopy than auscultation and percussion, and, like the latter, it is studied in special courses.   The method of teaching the subject which is followed by myself in my practical courses of instruction, and which is also adapted for private use, is as follows : My students are first taught the application of the various illuminating apparatuses, and are considered sufficiently well trained when they are able, by means of a concave mirror attached to the head and a laryngeal mirror, to project an image of the flame used into a narrow tube (thermometer-case or microscope tube) well enough to distinctly recognize in the mirror any marks on the bottom of the tube. They then practise upon a manikin, or other preparation, producing images of the larynx ; and finally upon a living subject, with a normal larynx, who has been well trained to tolerate the manipulations.   The preparation I use is a skull mounted upon a stand, with a larynx (taken from a subject) suspended within or beneath it.   Instead of a skull the apparatus prepared by Waldenburg for the purpose may be used.   Besides these there are manikins of papier maché or plaster.

In the actual performance of laryngoscopy the position of the patient is of prime importance ; the longitudinal axis of the cavity of his mouth must correspond with the direction of the rays of light employed, and with the axis of the observer's vision.   If the direction of the light employed is not subject to the examiner's pleasure, as when the direct rays of the sun are used, the patient must be accommodated to it, and if he be confined to the bed, the light must be directed to his mouth.   If, however, the physician is unhampered in this respect, as it is desirable he should always be, the patient should be seated straight in front of the examiner, with the head thrown slightly backwards, but still in a line with the axis of his body, and inclining neither to the right nor to the left.   A head-rest (Fig. 9, page 32) may usually be dispensed with.   The chair upon which the patient is to sit, and which he is very apt to move as he takes his seat, should be so arranged, in connection with the illuminating apparatus which is used, that the examination may be conveniently conducted.   In the foregoing pages the necessary position of the various illuminating apparatuses has been described, and we will now only remark that they must be arranged according to the patient's height, and that the mirrors, in practice as well as in theory, are to be placed in front of the patient's mouth at a distance corresponding to their focal length.   It will be found that the majority of patients will lose their erect posture during a long examination, and allow the head to sink further back, and that their position will often need to be rectified.   The physician, separating his knees, in order that the legs of the patient, kept closely together, may find room between them, accommodates himself to the height of the patient, so that he is able to look straight into the mouth of the latter.   The patient then opens his mouth as widely as possible ; the lips, especially the upper, should leave the teeth free ; if they do not, the patient may be requested to draw up his nose, in order to call to his assistance the *levator labii superioris alæque nasi* muscle, A moustache, if it be present, must be

FIG. 10.
Dummy prepared to receive a larynx, after Waldenburg.

a, Stand ; *b,* tube made of tin, which represents the mouth and pharynx.

pushed back ; and artificial teeth, unless firmly fixed, be removed, or held firmly in their place. The patient then stretches out his tongue as far as possible, and, after covering it with a single thickness of his handkerchief, holds it fast with the right hand, the thumb being below, and the first finger above. If the patient be too awkward, the physician himself, or an assistant, will be obliged to perform this simple operation for him—a procedure seldom necessary except in children.

The tongue should be protruded by the patient, and not drawn out, for by being stretched out voluntarily the hyoid bone and the larynx are raised, and the ascending portion of the base of the tongue is carried away from the posterior wall of the pharynx. Moreover, the muscular fibres which pass from the genio-glossus muscle to the epiglottis are put upon the stretch, and aid in drawing the latter forwards.[1] All these circumstances, therefore, tend to render the performance of laryngoscopy easier, and to bring into view, for the first time, the anterior portions of the larynx.

Attention being directed first, then, to the mouth and the pharynx—an examination of which should always precede that of the larynx, the patient must be taught that as often as the examiner says, "eh," he is to utter this vowel with a somewhat nasal tone, *breathing at all other times calmly and uninterruptedly*. The sound "eh" or "heh" being phonated by the patient, the pharynx and the larynx are brought into a suitable position for examination ; the latter rises, and the velum and uvula are lifted, while at the same time the tongue is depressed upon the floor of the mouth. The necessity of carrying on the respiration in an uninterrupted manner will be apparent without further explanation.

It is only after the patient is sufficiently well trained, as regards the holding of his head, the stretching out of the tongue, the breathing, and the phonation of the vowel " a " [eh], that the physician will be able to begin with the introduction of the laryngeal mirror. This latter must always be warmed to a blood-heat before being used, lest the moisture of the expired

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[1] Compare *Luschka*, Kehlkopf. Tübingen, 1871, p. 109.

breath condense upon its reflecting surface. This warming may readily be done by passing the polished surface of the glass to and fro over the flame of the illuminating apparatus, or holding it in a spirit flame kept in readiness for this purpose. The polished surface of the mirror alone is to be exposed to the heat, as it is the side upon which the moisture of the breath condenses, and if the back were to be heated, it might be found too hot for the patient to tolerate. It is even advisable, after warming the face of the glass, to take the precaution of testing the degree of heat of the back of the mirror by applying it to the hand, and thereby avoid any danger of introducing it too hot into the patient's mouth. Ziemssen uses a mirror furnished with a wooden back, instead of the ordinary one of German silver, in order that the mirror may retain the necessary amount of heat for a longer time. The warming of the mirrors in warm water, as is recommended by Liston, Türck, Bruns, and others, is less advantageous, because it is necessary to wipe them dry each time previous to their introduction into the mouth, and a loss of time is thereby occasioned, if the mirror be clean in other respects. For although a mirror should never be used upon more than one patient, without a thorough previous cleansing, it may often, upon the same one, be removed and reintroduced many times during the examination without becoming soiled and needing washing.

The laryngeal mirror is held in the same manner as a pen, by the thumb, forefinger, and middle finger, usually, of the right hand (compare Fig. 4). The examiner should, however, accustom himself, from the beginning of his examinations, to the use of the left hand also, as the employment of the latter is necessary in all local therapeutic and operative procedures, the right hand then being used for introducing the various instruments. As the patient phonates "eh," the mirror should be rapidly and unhesitatingly introduced from the corner of the mouth—its polished side being turned downwards towards the tongue, *until the uvula of the patient rests upon the back of the mirror, while at the same time the handle of the instrument remains in the corner of the mouth* (compare Fig. 4). During this proceeding the examiner should watch the mirror carefully with both eyes,

and avoid touching with it either the mucous membrane of the mouth or the tongue ; for if the latter be touched, the reflecting surface of the mirror will be tarnished, and if the palate or its arches, retching is likely to be produced. The hand holding the mirror must remain at the side of the mouth, and, after the mirror has been passed into its position, may find a point of support by resting the little finger upon the lower jaw of the patient. At the same time the other hand, which has been left free, corrects, if necessary, the position of the illuminating apparatus, and then is also placed upon the jaw of the patient—its thumb serving to steady the patient's hand holding his tongue, while the remaining fingers serve to keep his head in a suitable position.

The matter of greatest difficulty to the beginner is to introduce the mirror properly into the pharynx, and the following points, therefore, deserve attention. It should be passed into the mouth until its lower edge lies close to the posterior pharyngeal wall, and if the patient will tolerate the pressure, may even find a point of support by resting lightly upon it. By means of the back of the mirror, the uvula and velum are raised gently, and are retained in an elevated position, after being pushed upwards and backwards, as far as possible, towards the *pars nasalis pharyngis.* The angle at which the mirror is held, with reference to the axis of the body, is also of great importance. The angles of incidence and reflection being equal, a perpendicular erected upon the plane of the laryngeal mirror, at its centre, must form with the axis of the examiner's vision— this latter being identical with the principal axis of the entering light and the longitudinal axis of the patient's mouth—an angle equal to the one which it forms with a line drawn from the centre of the mirror to the point to be examined (compare Fig. 4.) For instance, if the examiner's axis of vision be made horizontal, and a perpendicular erected upon the centre of a plane passing through the glottis be supposed to intersect the horizontal line in the centre of the mirror, so as to form a right angle, the angle of inclination formed by the mirror and the horizontal line should equal forty-five degrees, in order that the examiner be able to illuminate the centre of the glottis and to

observe it in the image produced in the mirror.   This point, then, is the one which requires much practice before the necessary freedom of movement is attained by the examiner in his use of the laryngeal mirror, and he will only be sufficiently expert when he is not only able to obtain a laryngoscopic picture, but can introduce his mirror with the same ease with which he directs his eyes or places his limbs, so as to illuminate instantly any one special part of the larynx which he wishes to examine, and to produce a correct and clear image thereof in the mirror. To examine the posterior parts of the larynx, it will be necessary to hold the mirror at a more acute angle to the horizontal plane, while to examine the anterior parts the said angle must approach nearer a right angle.

It has thus far been taken for granted that the mirror is held straight in the pharynx, and not inclined to either side, that is, is not turned upon its longitudinal axis.   If it be thus turned, the image of the larynx will be changed.   If the side of the mirror on the examiner's right hand be raised, the left side of the patient's larynx will be seen in the mirror, and, *vice versa*, the right side when the left edge of the mirror is the highest.   This turning of the mirror from side to side is also employed when searching for the individual parts of the larynx we wish to examine.   Practice must teach the laryngoscopist the practical application of the principles here alluded to, space forbidding more than a mere mention of them at this time.

In the practical performance of laryngoscopy special obstacles are often encountered, which militate against the success of the operation.   For instance, individuals are met with in whom the *frænum linguæ* is so short that the tongue cannot be drawn sufficiently far forwards over the incisor teeth, and to examine them it is necessary that the tongue should be kept behind the teeth and upon the floor of the mouth, being usually pressed down by the disengaged hand of the operator, as has been described above when speaking of the inspection of the pharynx (page 4).   Again, the tongue may rise up in the mouth, even while the patient phonates the vowel "a" [eh], in which case it will also need to be depressed by the finger, as just described.

A still greater obstacle will be caused by the *irritability of*

the pharynx. The reflex movements of retching, which some-times render an inspection of the pharynx easier, are to be care-fully avoided during an examination of the larynx, and the mirror should be immediately removed as soon as the examiner sees, by the preparatory movements of the soft palate, that retch-ing is about to occur ; for if once caused, it will readily recur, and will prevent not only any further attempts at examination, but will cause a hyperæmia of the larynx which will last for some time. The contractions of the pharynx will, moreover, cover the mirror with the secretion of the parts, and render it unfitted for use until cleaned. All these circumstances, there-fore, render it a matter of considerable importance that the patient should be prevented, if possible, from retching during a laryngoscopic examination.

Before the various means for overcoming this irritability of the pharynx are spoken of, mention should be made of a form of irritability of the pharynx which is more *mental* than physi-cal, and which has already been alluded to on page 10. Such a form of sensibility may usually be overcome by performing a firm and rapid examination, even though it be incomplete, in order to acquire the confidence of the patient. On the other hand, apparent sensitiveness may be caused by an awkward examination, and beginners in the art should, therefore, care-fully avoid touching with their mirror those parts of the pharynx which are so irritable as to produce retching if inter-fered with. These parts, as has been previously stated, are the palate and the parts in its immediate neighborhood.

Besides these forms of sensitiveness, there exists also a true *hyperæsthesia of the pharynx*, and there are many individuals, especially among drinkers, smokers, and those with tubercular disease, in whom the mere stretching out of the tongue will pro-voke efforts at retching. In such cases where the reflex excita-bility is marked, many means have been recommended to lessen the sensitiveness of the pharynx, in order to permit of an exami-nation at the first sitting. Among these the use of cold, either in the form of ice or by means of an atomizing apparatus (see below), and the swallowing of a spoonful of cognac, or other spirituous fluid, after a previous gargling with it, have served

me best.   In order to overcome this irritability of the pharynx
for future examinations, we may advise the internal use of the
bromide of potassium, and the topical application of medicated
solutions suited to the pathological condition of the pharynx or
larynx (pencilling with astringents, etc.).   The patient may also
be requested to practise at his home, and under his own control,
the protrusion and fixing of the tongue, and, with the aid of a
mirror, in which he must at least see his uvula, the phonation
of the vowel "a" [eh], and to continue these exercises until the
movements named are made easy for him, and no longer cause
retching.

Other obstacles to the performance of laryngoscopy may be
presented by the pharynx, in the form of hypertrophied tonsils,
or a long pendulous velum and uvula.   In the first case, oval
mirrors must be used ;   and in the second, either as large a laryn-
geal mirror as possible, or the instrument prepared by Voltolini,
called the uvula-holder (Fig. 11).

Much more difficult to overcome than the preceding are the
obstacles to a complete examination of the larynx presented by
the epiglottis.   The elevation of this cartilage not being due
to any muscular apparatus of its own, it sometimes happens
that, although the tongue is well protruded, and the patient
phonates the vowel "a" most vigorously, the epiglottis is not
raised, but hangs over towards the posterior wall of the pharynx,
and most effectually prevents any view into the interior of the
laryngeal cavity.   Occasionally in such cases the epiglottis may
be raised under our very eyes, by causing the patient to phonate
a high "e."   The tongue, however, usually rises at the same
time, but may easily be prevented from obstructing the view by
depressing it with a spatula.   If these means prove unsuccessful,
the epiglottis must be raised by means of a suitable laryngeal
sound (Fig. 12), and, once having been elevated, by means of such
an instrument, it will fall backwards into its original position
so slowly that the physician will usually succeed, even after
removing the sound, in obtaining a view of the interior of the
larynx.   The elevation of the epiglottis by means of various
kinds of forceps, and by threads which are passed through it, are
procedures which ought only to be undertaken as preparatory

to intra-laryngeal operations, and are not necessary or advisable for the mere performance of an examination, on account of the danger which attends them.

The same measures may be undertaken by the physician to effect an examination, if the form of the epiglottis itself, espec-
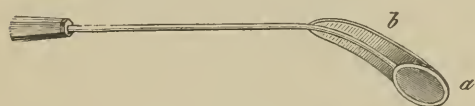
FIG. 11.

Laryngeal mirror, with uvula-holder, after Voltolini.

a. Laryngeal mirror ; b, metal plate which prevents the falling of the uvula. (In its place a piece of stiff paper may be attached to the handle.)

ially the so-called " Jew's-harp form," render the inspection difficult. Much will depend, in these cases, upon the accurate introduction of the mirror, in order that a picture of the interior of the larynx may be obtained through the narrow isthmus, which alone is left free between the inverted edges of the epiglottis. In order to effect this, the mirror will have to be placed lower and further back in the pharynx, or more nearly parallel to the axis of the body, than is usually done.
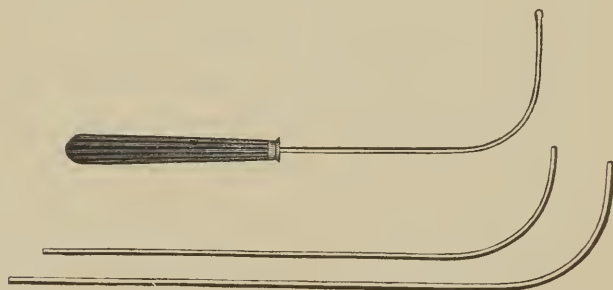
FIG. 12.

Laryngeal sounds.

1. Schrötter's sound, consisting of a flexible copper wire, covered by an elastic English bougie. 2. Flexible silver wire, with handle.

In the foregoing descriptions of the laryngoscopic process of examination, it has been presupposed that the patient affords willing aid to the efforts of the examiner. Should this, however, not be the case, the laryngoscopic examination will be rendered much more difficult. In young children, who even if they do not assist, at least do not intentionally oppose the operator's efforts, no special difficulty is encountered, as they may be examined even while screaming loudly. If, however, obstacles are intentionally thrown into the examiner's way, as is often the case with

children from two to eight years old, and with insane adults, and if all efforts at persuasion fail, he can only accomplish his purpose by force. The patient should then be held by assistants, and a gag introduced between the teeth ; after which the tongue should be drawn out with forceps (which, however, will only be needed in case of refractory or unconscious subjects), or, being held behind the incisior teeth, it may be depressed by means of a spatula. In making an examination under these circumstances, advantage must be taken of the moment in which the secretions collected in the pharynx are swallowed, and the examination then made as rapidly as possible.

If the physician follow the foregoing instructions carefully, he will succeed without difficulty in attaining his aim, that is, in making a complete laryngoscopic diagnosis at the first examination of the patient. Beginners very frequently charge their own want of skilfulness to the patient, and commit the great mistake of becoming impatient, or even angry. But it must be remembered that even an awkward and obstinate patient may, by patience and persistent instruction, be made to conform to the operator's desires as regards position, movements, etc., and
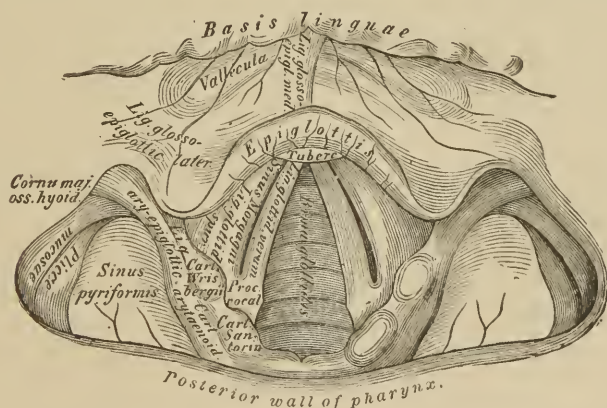
Fig. 13.
The laryngoscopic picture, double size, during quiet respiration.—*Heitzmann.*

that if success does not attend the first introduction of the mirror, a second may be tried. The laryngoscopist must therefore always appear to have an abundance of time, for he loses it by being hasty, and gains it only by being deliberate.

The length of time during which the mirror remains in position in the pharynx should be short ; and the physician will attain his purpose much more satisfactorily if he makes numerous short examinations, adding together, as it were, the images obtained in this way, than if he endeavors, in an untrained patient, to obtain a perfect picture of the whole larynx, in all its details, by means of one prolonged examination. The proof, then, of the laryngoscopist's skilfulness will consist in his ability to arrive at a correct diagnosis in all cases at the first examination. The exceptions, where this is not the case, must be so rare that the general rule as regards success will only be confirmed by them.

In examining the picture of the larynx and adjacent parts, as seen in the mirror [1] (Figs. 13 and 14), the first object which attracts attention is the *base of the tongue*, covered with glands but free from papillæ, and through the red mucous membrane of which a few veins can generally be distinctly seen. The epiglottis will next be presented to view, its suprahyoid portion rising about one centimetre (four-tenths of an inch) above the floor of the mouth. Its appearance is very variable, its lingual or anterior surface sometimes being more distinctly seen, as in the cut, at others its posterior or laryngeal surface. The free portion of the epiglottis is also subject to marked changes in its configuration. As a general rule, the two surfaces of the cartilage may be termed
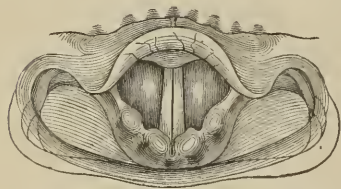
Fig. 14.
The laryngoscopic image in phonation.

"saddle-shaped," the arrangement being the reverse on one side from what it is on the other. Thus the posterior surface is concave from right to left, and convex from above downwards, while the anterior surface is concave from above downwards, and convex from right to left.

But it sometimes happens in adults, and commonly in children, that the pars suprahyoidea of the epiglottis appears simply as a channel or longitudinal trough opening posteriorly. In rare instances its sides are inverted posteriorly, and so nearly

[1] In this description we avail ourselves of the admirable anatomy of the larynx of von Luschka in his *Kehlkopf des Menschen*. Tübingen, 1871.

approach one another that they almost touch, and only a small longitudinal crevice is left between them (the Jew's-harp or omega form of epiglottis). As a rule, the upper free edge is slightly hollowed out in the middle, so that more or less of a median groove is apparent lying between two rounded corners, while occasionally this portion is pointed. This free edge is moreover sharp and thin, and turned over upon itself towards the base of the tongue. The upper edge of the epiglottis never touches the posterior wall of the pharynx when it is laid backward, a position which it assumes during each act of deglutition, not, however, by the force of any muscles of its own, but in a purely mechanical way, through the descent of the base of the tongue and the elevation of the larynx.

In consequence of the transparency of its cartilage the color of the epiglottis appears to be brighter and more of a yellowish red than that of the surrounding parts. Upon its lingual surface ramifications of vessels may ordinarily be distinctly seen in the mucous membrane, which is here much more loosely attached than upon the laryngeal surface. This latter surface, which in the drawing is all that can be seen of the epiglottis, decreases sharply in width from above downward, and constitutes, together with the ligamentum thyreo-epiglotticum, the anterior wall of the superior section of the larynx ; in the middle of this wall appears a protuberance, the *tuberculum epiglottidis*, formed by a collection of acinous glands.

From the epiglottis a fold of mucous membrane, called the *plica glosso-epiglottica media*, and containing a ligament of the same name, passes forward in the median line to be inserted at the base of the tongue. On either side of this fold shallow depressions, the *valleculæ*, may be seen, beneath which the body of the hyoid bone lies superficially, and may often be distinguished as a yellowish protuberance. On their outer sides these depressions are usually sharply bounded by the *plicæ glosso-epiglotticæ laterales*.

The fold of mucous membrane which passes backwards from the free edge of the epiglottis, that is, the *plica pharyngo-epiglottica*, has already been described (page 8, also Fig. 4). More important than this, forming a right angle with it, and sloping

gradually backwards, downwards, and inwards, towards the tip of the arytenoid cartilage, is the *plica ary-epiglottica*, the superior sharp edge of which forms the boundary line between the pharynx and the larynx, and limits the *vestibulum laryngis* on its outer side. At the junction of the posterior and middle thirds of this fold a small elevation is usually apparent, which marks the site of the *cartilage of Wrisberg*, and at its posterior extremity a similar elevation corresponds to the location of the *cartilage of Santorini*. Continuing the examination of the superior boundaries of the laryngeal cavity further posteriorly, while it is in a state of rest, the examiner will next observe the *rimula sive incisura interarytænoidea*, lying over the median border of the arytenoid cartilages, a point at which, in passing over the *musculus arytænoideus transversus*, the pharyngeal mucous membrane merges into the laryngeal. On the outer side of each plica ary-epiglottica lies the *recessus pharyngo-laryngeus*, or the *sinus pyriformis*—recesses of the pharynx, which unite with each other posteriorly behind the arytenoid cartilages, and lead down into the œsophagus. They are usually observed in the laryngoscopic picture as either filled with foamy secretion, or in the act of filling during the examination.

In this manner the free edge of the epiglottis, together with the ary-epiglottic folds, etc., form the upper limits of the *ostium pharyngeum laryngis*, which may be dilated or contracted through the action of its own muscles.

The plica ary-epiglottica, which stretches out over the *membrana quadrangularis* of the elastic membrane of the larynx, terminates below in the *false vocal cord*, or *ligamentum vocale spurium*. On the lateral wall of the upper laryngeal cavity, represented by the plica ary-epiglottica, and resembling in form an irregular quadrilateral, two small prominences or ridges are observed posteriorly, which run parallel to each other from above and behind, downwards and forwards ; the posterior one of the two corresponding to the anterior portion of the arytenoid cartilage, and the anterior one, which loses itself above in the cartilage of Wrisberg, being caused by an aggregation of glands. Together they form the upright bar of an L, the horizontal bar being represented by the glandular mass, which, together with elastic tissue,

forms the groundwork of the false vocal cord (*glandulæ aggregatæ laterales*.) Between these two prominences lies a channel or groove, to which Merkel has given the name *filtrum laryngis*.

Each false vocal cord extends from the angle of the thyroid cartilage to the fovea triangularis of the arytenoid cartilage, the two converging anteriorly so as to form an acute angle, and diverging posteriorly, leaving between them a space called the *false glottis*. Their course is not direct, but describes the segment of an ellipse. They may, under the influence of their own muscles, be shortened in an antero-posterior direction, as well as separated from one another, or brought together until they meet. During adduction of these cords the upper laryngeal space is shut off from the general cavity of the larynx, and assumes a wedge-shaped form, with a closed bottom. This approximation of the false cords always takes place during the act of deglutition, or when anything touches the interior of the larynx above. It also occurs when the false cords vicariously assume the function of sound-producing organs, an office which they never fill normally, but only under pathological conditions.

A normal laryngoscopic view shows the entrance only of the middle laryngeal space, which spreads out below the false cords, embracing, in reality, only the *ventricle of Morgagni*, but constituting a region of great pathological importance. The entrance thereto may be of very variable size.

A much more distinct view is obtained of the lower laryngeal cavity, the region of greatest functional importance. The superior surfaces of the true vocal cords, the *ligamenta vocalia vera sive inferiora*, are readily recognizable by their white ligamentous color, and are seen, in so far as they are not covered by the false cords, in their entire extent, from the angle of the thyroid cartilage to the processus vocalis of the arytenoid cartilage. Their white color depends essentially upon the fact that the capillary network of the vocal cords is by far less dense than that which is found in the remaining mucous membrane of the larynx. Occasionally small vessels, running in a longitudinal direction, are seen upon their superior surfaces. The vocal cords are anatomically distinguished from the general laryngeal mucous membrane by their covering of pave-

ment epithelium. The rest of the mucous membrane is every-
where covered with ciliated epithelium except at one spot, where
the pavement variety occurs in the form of a narrow strip lining
the pharyngeal orifice of the larynx, and turned in, as it were,
from the pharynx. Towards the rima the pavement epithelium
of the vocal cords becomes continuous with that of this strip.

The basis of the true vocal cords, which upon vertical sec-
tion present a prismatic form, is made up of the *musculus
thyreo-arytænoideus internus*, and the *membrana laryngis
elastica*, which latter, towards the free and sharp edge of the
vocal cords, develops into a true elastic cord.

The fibro-cartilage of the *processus vocalis* is usually easily
distinguished at the posterior extremity of the vocal cord, as a
yellowish spot, and a similar spot is occasionally seen at the
anterior extremity, dependent upon the presence of a small car-
tilaginous nodule.

Immediately below, accompanying and parallel to the free
edge of the cord, runs a narrow, sharp fold of mucous mem-
brane, sometimes visible in the laryngoscopic image. In the
anterior commissure of the cords, a small fold, wrinkled trans-
versely, slanting posteriorly, and presenting a bevelled posterior
margin, may sometimes be seen.

The true vocal cords constitute the limit of the anterior and
greater part of the *rima glottidis*. Posteriorly they are continu-
ous with the median, triangular surface of the vocal process of
each arytenoid cartilage, the latter being covered only by a mu-
cous membrane, which is closely adherent to the perichondrium.
The rima glottidis may, therefore, be divided into an anterior or
ligamentous, and a posterior or cartilaginous, portion, this divi-
sion corresponding with the now antiquated one of a *glottis
vocalis*, and a *glottis respiratoria*. This chink of the glottis—
which in the cadaver constitutes an isosceles triangle, the base
of which measures about one-fourth or one-fifth of the length of
one of the sides, which in the male are about one inch, and in
the female three-fifths of an inch long—is, apart from the differ-
ences caused by age and sex, subject to the most marked changes
in form, in the same individual, these changes being dependent
upon the various phases of respiration and phonation. During

each inspiratory act, for instance, the glottis opens widely, and if the inspiration be unusually deep, the median prominence upon the lateral wall of the larynx may disappear, so that the latter will present the appearance of a tube of uniform calibre throughout. During phonation, on the contrary, the vocal cords approach one another, the vocal processes touch, and a narrow slit alone remains open between the cords, the shape of which, as regards form, length, and breadth, will depend upon the register as well as upon the height and strength of the note produced.[1] The vibrations of the cords producing this note can in many cases be distinctly seen.

If the glottis stand open, the posterior wall of the larynx is seen in its most favorable position for study. It forms the background of the larynx, containing the *glandulæ aggregatæ posteriores*, and its lax mucous membrane, even when completely stretched, will still show longitudinal foldings.

The true vocal cords serve the purpose, so to speak, of *landmarks* in the laryngoscopic image. They are very distinctly marked by their white color, and the examiner will have no difficulty, after having once identified them, in locating the surrounding parts.

The law in physics, that the image seen in a mirror appears to be as far behind the mirror as the reflected object stands in front of it, also holds true, of course, in laryngoscopy, and in consequence an apparent displacement of the parts occurs, which is worthy of our attention. A plane passing through the larynx on a level with the glottis will be nearly horizontal, and will, therefore, form with the laryngeal mirror, an angle of forty-five degrees, and the image of this plane will appear in the mirror as almost perpendicular, that is, the parts which in reality lie anteriorly will appear above in the mirror. This deviation would be much more apparent were it not compensated for in some degree by the direction of the laryngeal orifice, which, as has been already stated, slopes downwards and backwards from the free edge of the epiglottis to the tips of the arytenoid cartilages. The practical importance of this matter will be fully apparent to the

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[1] Compare *Karl Ludw. Merkel*, Anatomie u. Physiologie des menschlichen Stimm- und Sprachorgans. Leipzig.

examiner when he is about to introduce an instrument into the larynx, and is necessarily obliged to compensate, by the direction of his movements, for the amount of deviation caused by the refraction of the mirror. There is no other deviation but this caused by the position of the mirror; that which appears on the right lies on the right, but it is self-evident that that which corresponds to the examiner's right, must be on the left of the patient, who sits opposite him, and *vice versa.*

A laryngoscopic examination should only be considered as complete when the whole larynx has been carefully inspected. In an examination, as the mirror is passed deeper into the pharynx, the posterior parts of the larynx usually appear, in the laryngeal picture, immediately after the base of the tongue and the epiglottis, and therefore the point most difficult to accomplish is to obtain a good view of the anterior commissure of the vocal cords. The larynx should be examined both when the glottis is opened and when it is closed. If we wish to observe the latter condition, the patient may be directed to phonate, in which case the vocal cords will be visible throughout their entire extent; and, if we wish to have the glottis open, he may inspire deeply, when we shall be able, if the mirror is at the correct angle and the illumination sufficient, to look down into the trachea, and even to see its bifurcation. During the latter act, also, the posterior wall of the larynx—a locality most important on diagnostic grounds—is placed under the most favorable conditions for examination, and the incisura interarytænoidea may be thoroughly inspected.

The examiner must necessarily be content with observing the parts as they are presented to his eye by the laryngeal mirror, and although, by changing the position of the latter, he is sometimes able to obtain a better view, a complete one of all the parts is impossible. As a general rule, the statement holds good that in laryngoscopy we cannot, as in the open larynx of the dead subject, obtain a front view of those parts which appear in profile, or a profile view of those which are seen from in front. This fact is especially true in regard to the examination of the posterior laryngeal wall, which appears in the mirror, in transverse section, almost reduced to the width of a line.

To obviate this difficulty, Löri has, in a recently published communication,[1] recommended the use of two mirrors besides the one ordinarily employed. According to his method the latter merely serves for the purpose of illumination, while one of the former—a small laryngeal mirror simply reversed so that its reflecting surface looks backwards—is introduced further towards the front, so as to obtain as nearly as possible a direct picture of the posterior wall of the larynx, similar to that which the eye would see if looking directly over the epiglottis. This picture it reflects to the third mirror, which is attached to the first or illuminating mirror at an angle of 125°, whence the image is conveyed to the eye of the observer. The same effect may be produced, according to this author, by the use of a prism instead of the three mirrors.

In making a laryngoscopical examination, the *color* of the parts should first receive attention ; and here the examiner must be careful not to be misled by the deviations from the normal color which are caused by the use of artificial light, and to remember specially, that although the vocal cords are usually seen to be of a white color, or even glistening like mother-of-pearl, they may, in perfectly normal cases, be of a pale rose color. Their flexibility, and the absence of all swelling, will serve to differentiate such a case from one of hyperæmia. It may be said, in general terms, that hyperæmia and anæmia, as well as all other changes of color, look just the same in a mirror as out of a mirror.

In regard to *form*, the examiner must ascertain whether swelling, defects, new-formations, or other anomalies are present, and pay particular attention during his inspection to those parts of the larynx which are only seen in profile. A loss of substance is, for instance, difficult of detection if situated on the posterior wall of the larynx, while if upon the free edge of the vocal cord, even though very small, it is readily distinguished. In like manner, but a small excavation may often be seen during life in the neighborhood of the processus vocalis, which, when seen after death and viewed from in front, is recognized as the entrance to a large and deep ulceration.

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[1] Pesther med-chirurg. Presse, 1874, No. 25.

In regard to swelling, the region in the immediate vicinity of the processus vocalis—especially those parts covered with glands—demands careful observation. A swelling at the base of the tongue causes the epiglottis to appear shortened, and may lead to the diagnosis of a deficiency of that part.

The calibre of the larynx must also be carefully examined, to ascertain whether there be any enlargement or contraction of the cavity, whether foreign bodies or secretions are present, and the character of the secretion, if any. The latter may be mistaken, in certain cases, for swellings; but a differential diagnosis is easily made, as the former may be coughed out, or removed mechanically if necessary.

Finally, notice must be taken of the general *movements of the larynx;* whether the action of the arytenoid cartilages during inspiration, expiration, and phonation, are otherwise than normal; and whether the configuration of the opening of the glottis, the tension of the vocal cords and their vibrations, are all as experience has taught us they should be in a perfectly healthy larynx.

The further discussion of the points just mentioned must be left for the special parts of this work—but enough has already been said, in this short review, to indicate the important results, from a diagnostic point of view, which may be obtained by means of the laryngoscope. This method of examination will be still more highly prized when we remember that its revelations are made through the most accurate of our organs of special sense—the eye.

The surgeon may readily succeed in demonstrating the laryngeal picture to bystanders. *The demonstration of a laryngoscopic image* may be conducted either in such manner that, the mirror being fixed within the throat, several persons may observe it in turn, or in such a way that others may look into the larynx at the same time with the operator. For the purpose of fixing the mirror in position, special apparatuses attached to the patient's head, or to stands especially prepared for the purpose, have been employed; but the examiner will find it much easier to introduce the laryngeal mirror in the usual way, and, after fixing it firmly with his hand, to move his head to one

side, in order that a second person may occupy its position. If we wish to employ this second method of demonstration, a still better plan is for the student or person to whom the surgeon wishes to demonstrate the larynx, and whom we will call our associate, to bring his eye as near as possible into the axis of vision of the operator, preferably upon his right side, without interfering with the course of the reflected light, and to look with him into the patient's mouth, and upon the laryngeal mirror. This method, however, though the simplest for laryngoscopic demonstration, presents some inconveniences to all concerned, and it will be found preferable in practice to place a prism[1] near the axis of vision of the surgeon—at the point where before the head of the associate was placed—which will make it possible for the latter to look at the same time, and in the same direction, with the surgeon. Or, instead of the prism, a small plane mirror may be used, which, being movable, the associate may arrange in such a manner that he will see the picture of the larynx in it. Such mirrors are attached to the illuminating apparatuses shown in Figs. 5, 7, 8, and are called supplementary mirrors. Siegle has recently described such a form of apparatus which may be attached to every reflector.[2]

If the prism or the mirror is placed in the right position, the associate will see exactly the same picture as that which is conveyed to the eye of the surgeon, and the only point to which it will then be necessary to give attention is, that the former will be obliged to accommodate his eye to the distance of eleven inches, plus the additional distance which lies between it and the mirror or prism.

Auto-laryngoscopy is performed in a similar way to that of the demonstration just described. A second or counter-mirror is employed, as recommended by Garcia, and the laryngeal mirror is introduced into the examiner's own throat, in precisely the same way as is done in examining others. Auto-laryngoscopy offers, therefore, an excellent method for attaining dexterity in the introduction of the laryngeal mirror, as any faults in

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[1] *Bose*, Deutsche Klinik, 1866, No. 15.
[2] Berl. klin. Wochenschrift, 1874, No. 23.

the manipulation will be experienced at once by the operator in his own person. The picture obtained of the larynx will lie at a considerable distance from the eye of the observer, the distance being made up of the distance of the counter-mirror from the eye, the distance of the counter-mirror from the mouth, and the distance from the mouth to the glottis, in most cases amounting altogether to some seventeen or eighteen inches. For this reason, therefore, even slightly myopic persons will need to wear spectacles during the performance of auto-laryngoscopy. In my courses of instruction I have sometimes discovered that some of my pupils were myopic, who had never been aware of it, through the circumstance that they were unable to recognize the auto-laryngoscopic image.

In view of the importance of laryngoscopic examinations, the attempt was early made to magnify the laryngoscopic image. For this purpose Türck applied a telescopic apparatus behind the perforation in the concave or reflecting mirror. Wertheim devised concave laryngeal mirrors, which I use at the present time in preference to other methods, on account of their simplicity and correctness. Weil (l. c.) employs lenses, which are placed between the reflector and the laryngeal mirror. In the practical application, however, of both concave laryngeal mirrors and lenses, a difficulty is presented by the optical law which regulates the magnifying process; according to this, magnified pictures can only be produced when the object to be magnified lies within the focal distance of the mirror or lens, and, the distance of the eye and of the object remaining the same, the magnifying power becomes greater the shorter the focal distance of the mirror or lens. As the concave mirrors we can use must necessarily have a focal distance of more than three inches, and one of at least seven or eight inches, if the picture to be produced is not to be distorted, it will readily be seen that they will magnify only to a very small extent. But in using lenses, those with a focal distance of seven inches may be placed close to the mouth of the patient, while those with a greater curve, and a focal distance of but four inches, may (if attached to a handle) be introduced within the mouth. In either case the lens must not be held at right angles to the axis of

vision of the observer, lest disturbing reflections impair the correctness of the image obtained; and it must also be warmed to a blood-heat, lest the moisture of the breath collect upon it. The magnifying power obtained by these means is stronger than that of concave mirrors; but the application of the lens is much more troublesome than that of the mirror, and requires the use of both of the examiner's hands. In the use of either, the course of the rays of light will be so changed that the image of the flame will be brought nearer to the reflector; the change, however, will not be so great as to necessitate any change or correction in the illuminating apparatuses previously described.

If a tracheotomy wound exist, the examiner may attempt to obtain a view of the larynx by means of a small mirror, introduced into the trachea, with its reflecting surface looking upwards. If the canula be retained during this examination, it must be provided with a suitable opening upon its upper surface.

INSPECTION OF THE NOSE FROM THE FRONT.

To view the cavity of the nose from the front, the nostrils of the patient need to be dilated as widely as possible, and to effect this, instead of the instruments formerly used, resembling ear specula, I have devised the *nares speculum* represented in Fig. 15. The branches, *a*, are made of strong (aluminium) wire. Instead of the fenestrated blades shown in the cut, Tröltsch employs solid blades, of about an inch in length, which stand at almost right angles to the branches.[1] The blades are introduced at the same time into both nostrils as far posteriorly as the cartilages of the alæ, leaving the septum free between them. They are then separated as far as possible, by means of a screw attached to the extremity of the instrument, *b*. The instrument, thus introduced, will remain in position without support, provided it is of sufficient strength to resist the muscular movements of the patient's nostrils which tend to approximate the

FIG. 15.
B. Fraenkel's Speculum narium.

[1] Ohrenheilkunde. Leipzig, 1873, p. 297.

blades. Both blades may also be introduced into one nostril, the branches resting, one against the septum, the other against the ala; but this method will be much less agreeable to the patient than the former, owing to the greater susceptibility of the septum. The speculum then having been correctly introduced as described, the nostrils are dilated as widely as possible and can be freely looked into. The point of the nose may also be held up by way of assistance, and any hairs which interfere with the view removed with the scissors.

The nose being thus prepared, everything can be seen which is accessible to the eye in this region, and no further aids to an examination are required, with the exception of suitable illumination. Whoever wishes to satisfy himself of the eminent advantages offered by the use of reflecting mirrors in examining the cavities of the body, will find a fitting subject for experiment in the nose. With reference to the method of illumination, that is, to the production of the flame-image with a concave mirror, we refer to the explanations of this given above. In the absence of sunlight the employment of this method of illumination cannot be too strongly recommended. The distance of the flame-image from the mirror may here be regulated by the seeing distance of the observer as well by the reflector that may happen to be at hand for other purposes, ophthalmoscopy for instance; only it is well to produce a small flame-image, as brilliant as possible, and to throw this in accurately.

If the method of examination which has just been described be followed, the only limit to the surgeon's field of inspection will be that which depends upon the natural configuration of the parts. I have found that what it is impossible for me to see by this means will also remain invisible to me, even though I have recourse to any of the many expedients which have been advised. Among these may be mentioned Wertheim's "Conchoscope," [1] with which I can see scarcely anything, Voltolini's method of introducing a polished bar of metal for the purposes of illumination, and finally, the many forms of tubes and mirrors, intended to be introduced into the anterior nares, for the purpose of displaying parts otherwise concealed, such as the

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[1] Wiener Medicinische Presse, 1869, No. 18.

upper part of the middle fossa ; all of which have also, thus far, failed to reveal anything new to me.

The parts which can be seen in making such an examination will be, 1, the entire anterior portion of the nasal cavity, from the superior turbinated bone to the floor ; 2, the anterior portion of the middle turbinated bone ; 3, the anterior and inferior surface of the inferior turbinated bone ; 4, the surface of the septum ; and lastly, in the majority of cases, the greater part of the inferior meatus of the nose.   If the meatus be large and wide, the exam- iner will be enabled to look directly through it at the posterior wall of the pharynx, and may observe the movements of the muscles which take their origin at the pharyngeal orifice of the Eustachian tube.   The nasal passages are seldom of equal size, and a deflection of the septum, usually towards the left, is very commonly observed.   The turbinated bones appear in a normal state as pale, red protuberances, usually covered by a mucous secretion, the amount as well as the color of which varies much within normal limits, and the limits of the latter can only be learned by the experience gained through frequent examinations. If the amount of secretion be so great as to interfere with the examination, it may be washed out by means of a syringe.   In an anterior rhinoscopic examination, too, careful attention is to be paid to any alterations from the normal color, to swellings or hypertrophies, as well as to changes in configuration, amount of secretion, the presence of ulcerations, etc., etc.   These matters cannot be discussed in detail in this part of the work, but will be treated of hereafter.   We cannot refrain, however, from once more calling attention to the importance of the method, espe- cially with reference to otology.   As regards demonstrations and apparatus for magnifying the rhinoscopic picture, the reader is referred to what has already been given in a previous chapter, when speaking of the same subject in connection with laryn- goscopic examinations.

RHINOSCOPY.[1]

Czermak was the first to apply the term "rhinoscopy" to a

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[1] Besides the majority of text-books on Laryngoscopy, compare *Semeleder*, Die Rhinoskopie. Leipzig, 1862, and *Störck*, Laryngoskopie. Wien, 1859.

method of examination by means of which the naso-pharyngeal cavity and posterior portion of the nasal cavity could be inspected through the pharynx. Although it is questionable whether it is well chosen, it is perhaps advisable, out of respect for the memory of the discoverer of the art, to retain the term, which is now sanctioned by custom, in the same sense that was given to it by him.

That Czermak was the inventor of the method cannot be doubted, for although other observers, especially Bozzini (l. c.), had previously claimed to have seen objects hanging behind the
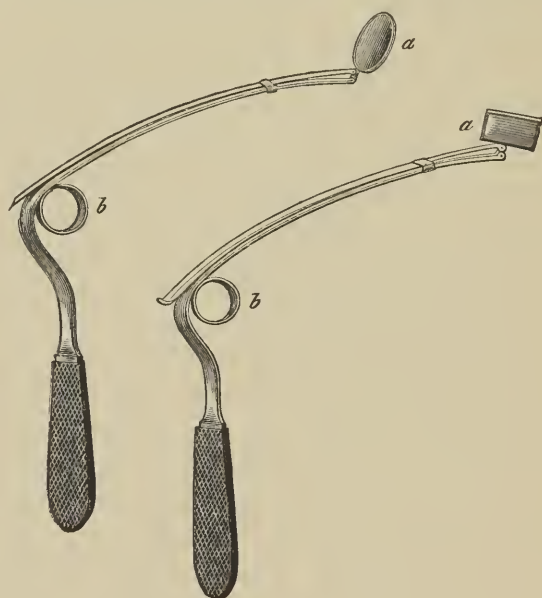
Fig. 16.
Fraenkel's rhinoscope.

soft palate by means of a mirror, at the time that Czermak published the result of his labors, and gave the perfected method to the profession, it was so entirely unknown that even Türck still maintained that it was impracticable.[1]

For the purposes of rhinoscopy, the only instruments which are required are, 1, a tongue spatula (see p. 6); 2, a suitable

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[1] *Czermak*, l. c., p. 42. *Semeleder*, l. c., p. 2. Here one may find the entire previous literature of the subject cited.

means of illumination, which is used under the same conditions as in laryngoscopy, and the reader is therefore referred to page 16 et seq. ; and 3, a pharyngeal mirror. An ordinary laryngoscopic mirror may be used instead of the latter, but it will be found more practical to use mirrors such as are represented in Fig. 16, which are especially prepared for the purpose, and which differ from the laryngeal mirror only in the form of the rods and handle. The drawing represents a modification of the pharyngeal mirror, introduced by myself, in which a square or round mirror (a) can be made to change the angle at which it stands upon the rod ; this is accomplished by means of a sliding bar, which reaches to the handle of the instrument, and, when moved up and down, causes the mirror to revolve about an axis (b) running at right angles to the rod.

The same rules with reference to the position of the patient, the position of his head, and the direction and method of illumination, apply in rhinoscopy as in laryngoscopy, with the one exception, that the patient, after opening his mouth widely, should allow the tongue to remain behind the lower incisor teeth, where it may be depressed by a spatula, according to the method described when speaking of the inspection of the pharynx (p. 6). The patient himself, if sufficiently adroit, may hold the depressor firmly with his right hand, after it has been placed in position by the examiner. The latter then introduces the mirror into the pharynx by passing it as closely as possible over the lower teeth and along the back of the tongue in the median line, until it is in the free space between the base of the tongue, the laryngeal opening, the posterior wall of the pharynx, and the velum palatinum. It should not stand directly in the median line, on account of the uvula, which would lie in front of it and obstruct the view, but rather on the right or the left side, under one or the other of the arches of the soft palate, with its upper edge brought close to the posterior wall of the pharynx. The problem to be solved in introducing and placing the mirror, is not to touch the patient. If my rhinoscope be used, it should be introduced into the mouth with the mirror lying depressed in the direction of the handle, until its upper edge approaches closely the pharyngeal wall ; by then drawing upon the ring the mirror

may be gradually raised until it forms almost a right angle with the rod, while at the same time the end of the instrument is gradually lowered towards the mouth of the larynx.

The introduction of the rhinoscopic mirror also requires practice, and beginners usually fail because they not only touch and irritate the parts while introducing it, but also raise the rod of the instrument too far above the lower incisor teeth, and do not introduce the mirror either low enough or far enough back into the pharynx. It also requires considerable practice to be able to recognize readily the various parts of the rhinoscopic picture, and the examiner will find the septum to be a valuable landmark, it being easily recognized as a thin, straight partition, extending in the median line from above downwards, growing thicker anteriorly, and dividing the posterior nares into two equal halves. The walls seen in the rhinoscopic mirror join each other at various angles, and in order that the cavity which they enclose, seldom exceeding in size a walnut, may be thoroughly inspected, it will be necessary to change the angle and position of the mirror considerably, and turn it in all directions. It is for this reason that I introduced the above-described modification of the ordinary rhinoscope into my instrument, and in using it it will be readily understood that when the mirror lies nearly horizontal in the pharynx, a view of the posterior parts will be afforded; while, if it forms a right angle with the rod, the parts lying anteriorly will be reflected in the mirror, and the more the edge of the mirror towards the examiner's left side be turned downwards, the more of the right wall of the patient's pharynx can be seen, and *vice versa*. These points are of more importance and demand greater attention in the performance of rhinoscopy than in that of laryngoscopy, and the surgeon will therefore need to practise them faithfully until he is perfectly familiar with their practical application. When they are once understood, it will be easy for him to recognize readily the various parts of the constantly changing picture revealed to him by the rhinoscope,—changes which depend upon the position of the mirror and the individual patient.

Posteriorly in the rhinoscopic view appears the *fornix pharyngis*, the vault of the pharynx, which is attached to the

base of the skull and the anterior surfaces of the bodies of the cervical vertebræ, merging below into the posterior wall of the pharynx. Its red mucous membrane will appear in the perspective view as shortened, although, in consequence of its position, not so much so as the posterior wall of the pharynx, as seen in the laryngoscopic picture. Its surface is covered with ridges, running irregularly, occasionally in a longitudinal direction, and its structure can be more or less distinctly seen, consisting of a dense adenoid tissue, on which account this region deserves the name of *tonsilla pharyngea*. Occasionally an orifice, the size of a poppy-seed, which represents the opening of the *bursa pharyngea*, can be detected; this latter consists in a sac which lies immediately behind the mucous membrane, and is probably connected in embryonic life with the pituitary body. Laterally the posterior wall of the pharynx loses itself in the *recessus pharyngei*, or the fossa of Rosenmüller, from which anteriorly rise on either side the pharyngeal extremities of the Eustachian tubes. By looking on both sides of the septum, towards the front, through the posterior nares and into the cavity of the nose, the posterior portion of the middle turbinated bone and part of the middle meatus of the nose can be distinctly seen. Parts only of the superior and inferior turbinated bones, and of the inferior meatus of the nose come within the field of vision, varying greatly in extent. With the exception of the septum, the mucous membrane covering the walls of this region has a fresh red color; the turbinated bones, usually covered with more or less mucus, stand out in contrast thereto, appearing as steel-gray or yellowish-red protuberances. The erectile bodies [1] found on the posterior portion of the turbinated bones frequently lead to sudden swellings.

In the lower part of the rhinoscopic image we overlook the whole nasal surface of the velum. The lateral wall especially engages our attention. Here, as has been already mentioned, the pharyngeal orifice of the Eustachian tube protrudes forwards from the fossa of Rosenmüller, from the lower edges of which

[1] Vide *Kölliker*, Gewebelehre. Leipzig, 1867, p. 741, twelfth line from bottom.— EDITOR'S NOTE.

run downwards and inwards two folds of mucous membrane, which are termed respectively *plica salpingo-pharyngea* and *plica salpingo-palatina.*

The surrounding, very movable, muscular apparatus sometimes piles the mucous membrane up like a tumor against the velum.

The large size of the pharyngeal extremity of the Eustachian tube, and especially of its orifice, into which the little finger can be introduced, commonly excites the wonder of beginners in the art, and this is explainable when it is remembered how little attention is paid to this important region in dissections and post-mortem examinations, and that commonly the surgeon receives his first idea as to the appearance of the parts from a rhinoscopic examination made in the living subject.

The appearances just described are shown in figures 16 *a* and 16 *b*, taken from Luschka's work.

For information concerning the pathological changes which occur in these parts, the reader is referred to what has been already said when speaking of this subject in connection with the examination of the larynx. One point alone may here be mentioned, and that is, that the parts lying immediately below

FIG. 16 *a*.

Anterior view of the naso-pharyngeal space : on one side the mucous membrane has been dissected away (after Luschka).

1, Septum ; 2, middle and 3, lower turbinated, bone ; 4, tuberosity of the pharyngeal orifice of the Eustachian tube ; 5, soft palate, along the lateral border of which runs the plica salpingo-pharyngea ; 6, uvula ; 7, musculus salpingo-pharyngeus ; 8, levator veli ; 9, musculus pharyngo-palatinus.

the pharyngeal orifice of the Eustachian tube are often seen to be of a yellowish color, and not of the bright red which characterizes the mucous membrane of the remaining parts.

Besides the difficulties encountered in an examination of the pharynx, mentioned on page 10, another and much more serious one presents itself in the performance of rhinoscopy, often caus-
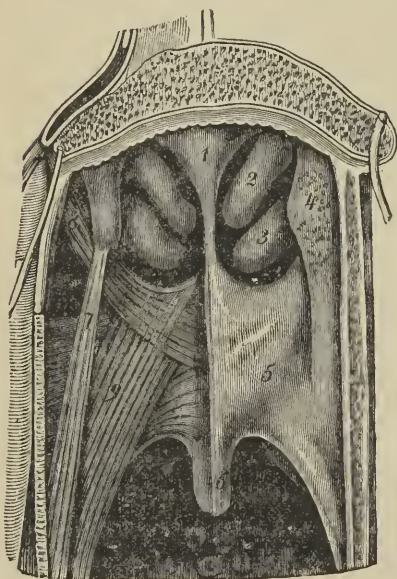
ing great embarrassment. This arises from the position of the soft palate. It is a *sine qua non* in rhinoscopy that this should not touch the posterior pharyngeal wall, and, easy as the matter seems to be, it will often be found to present an insurmountable obstacle. For our purposes the soft palate must be in a state of rest. If the examiner were only able, as he is in laryngoscopy, to cause the patient to execute movements which would assist his purpose, his task would be rendered considerably easier. But neither the phonation of strongly nasal sounds (Czermak), nor rapid and short respirations (Türck), nor the attempt to cause the patient to breathe exclusively through the nose (Löwenberg) will answer. For the position which we desire the velum to assume is precisely that which it takes when all muscular movement is suspended, and it therefore often becomes a genuine trial of patience to train a person to the task. Nor must it be supposed that uneducated persons are the most difficult to train to such a thing. It will be found that educated people, linguists, musicians, etc., are the very ones who try our patience most. The more they try to aid us, the more certain are they to make movements of the pharynx, which will perhaps completely frustrate the physician's efforts. Yet it is absolutely necessary to train the patient, so that he will hold his mouth open and

Fig. 16 b.

Front view of the naso-pharyngeal cavity, with the ordinary fissured appearance of its adenoid tissue (after Luschka).

1, Pterygoid process; 2, vomer; 3, posterior portion of the roof of the nasal cavity; 4, orifice of Eustachian tube; 5, mouth of the bursa pharyngea; 6, recessus pharyngeus, or fossa of Rosenmüller; 7, irregularly fissured surface of the adenoid tissue, which lifts up the mucous membrane into a number of low hills.

allow his tongue to be depressed without moving the velum, especially without drawing it up towards the posterior wall of the pharynx. This can only be accomplished by a thorough training, in the majority of cases carried out according to the method described above (page 42), for overcoming the sensitiveness of the pharynx. If then the first sitting be fruitless, the patient may, after having examined his own pharynx by means of a mirror, and having had the position which the velum

should occupy pointed out to him by his surgeon, practise in front of a mirror at his own home. Time for this preparation will always be afforded, as rhinoscopy is seldom urgent. Occasionally a rhinoscopic examination may be made if, as in laryngoscopy, the patient is examined with the tongue protruded and held in a fixed position, a method which has hitherto been but little employed. By these means, then, the surgeon will attain his object with the great majority of persons, but some will still remain in whom he will find it impossible to cause the velum to assume the correct position for an examination.

It is in these latter cases that certain instruments, formerly considered universally necessary, will have to be used in order to draw the velum away from the posterior pharyngeal wall; the amount of force employed being, as a matter of course, moderate. For the purpose of effecting this object, inventive skill has done all it could, and very many instruments, some of them quite ingenious, have been devised, a few of which would seem to be adapted to enlarge the pharynx, both "certainly and permanently" (Störck). I have, however, seen but little benefit from the use of these instruments, and find, as my experience increases, that the careful training of the patient is of much more avail than the exertion of any amount of force, however gently applied, by means of instruments.
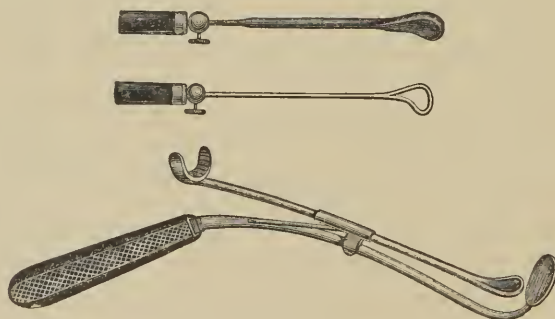

FIG. 17.
Uvula holders. Rhinoscope with uvula holder, according to Baxt.

The instruments alluded to are either made in the shape of a hook, a noose, a forceps, or a spoon (Fig. 17), or consist in fenestrated blades, in place of which latter my fenestrated spa-

tula (Fig. 1) may be used. Following the example of Stork,[1] Baxt,[2] and others, I have attached a uvula elevator to the rhino-scopic mirror itself (Fig. 17), by means of which the operator is able to manipulate the spatula, mirror, and uvula elevator him-self without having the assistance of a third hand. For a long time I used a small India-rubber tube, which, being applied to the uvula by means of a small, cup-shaped extremity, and the contained air being exhausted, attached itself so firmly to the uvula that the whole velum could be drawn forwards. The best instrument, however, for the purpose is Türck's simple thread noose, introduced through a small silver tube. It possesses many advantages, among which the fact that the thread does not intercept any of the light in its passage through the mouth, is by no means the least. All these aids, however, are liable to the common objection that we fail to accomplish our object in spite of them. For although the velum may be elevated by instru-ments so that that part of the posterior pharyngeal wall formerly covered by it may be seen, the contractions of the upper con-strictor muscle of the pharynx, excited by this procedure in such persons, will effectually prevent rhinoscopy. Whilst, therefore, laryngoscopy is possible in all cases, there will always be a cer-tain number of persons in whom rhinoscopy is impossible ; their number will, however, stand in inverse ratio to the skill and per-severance of the examining physician.

Another special obstacle to the complete performance of rhinoscopy is afforded by the presence of a large air-bubble, fill-ing the space between the velum and the posterior pharyngeal wall. If the examiner does not succeed in rupturing it by blowing into the mouth of the patient, or if for æsthetical rea-sons he does not choose to adopt this method—which, to say the least, is not very agreeable to the patient—he may break it easily and rapidly by means of the edge of his mirror.

Finally, in regard to the demonstration of the rhinoscopic picture, to means for magnifying the same, and to the perform-ance of auto-rhinoscopy, it will be sufficient to refer the reader

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[1] Zur Laryngoskopie. Wien, 1859, p. 20.
[2] Berl. klin. Wochenschrift, 1870, No. 28.

to the full discussion of these subjects under the head of Laryngoscopy (pp. 54, 55), for the application of the principles there explained will scarcely require any modification for rhinoscopic purposes.

TRANSILLUMINATION.

Czermack [1] has described under this name a method by which, with the aid of a laryngeal mirror introduced in the ordinary way, the larynx is made visible by means of a strong light thrown upon the neck externally. For this purpose sunlight may be directed, by means of a reflector, upon the tissues covering the larynx, the interior of which will then radiate a strong reddish light. Voltolini has availed himself of this method for the examination of the nose, by having the light thrown through its walls, either from the outside or through the septum, from one nasal passage, and he is the only author who has published any practical results as secured by this method. [2] The method can only be of use in ascertaining the relative proportions as regards thickness of either the whole wall of the larynx or any of its parts, which are thus rendered transparent. The process has also been applied by Schrötter, [3] to determine the degree of transparency and thickness of a membrane lying between the vocal cords.

PALPATION.

However brilliant may be the diagnostic results which the surgeon obtains by means of inspecting directly the regions of the body now under consideration, palpation is absolutely necessary to render the conclusions which he has arrived at certain in all respects ; for besides aiding him very materially to detect changes in form, the procedure is the only one which will assist him in ascertaining the degree of elasticity and the consistency of the parts under examination. Palpation, therefore, should never be omitted in cases where possibly it might render valuable assistance. The precautions to be taken by the surgeon when introducing his finger into the patient's mouth, have

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[1] L. c., p. 29.   [2] L. c., p. 119.

[3] Jahresbericht der Klinik für Laryngoskopie, 1870. Wien, 1871., p. 68.

already been alluded to (p. 5), and as the process is a very simple one, his attention is only called to the following points : By passing the forefinger behind the velum, and then turning its point upwards, we are able to touch not only the entire pharynx, but also the naso-pharyngeal cavity. Palpation of this region, as a means of diagnosis, was first recommended by Meyer, of Copenhagen, but is still practised far too little. The surgeon, having placed himself in front of the sitting patient, directs his forefinger into the pharynx of the latter, and during quiet inspiration passes it without force behind the velum, as far as to the posterior nares. The posterior surface of the velum, the septum, the pharyngeal orifices of the Eustachian tubes, the fossæ of Rosenmüller, and the fornix pharyngis, are then easily touched and examined. For the patient's right side the examiner's left forefinger will be found most convenient, and *vice versa*.

In so far as the lateral parts of the pharynx are without bony walls, they may be examined by the combined method—that is, by palpation externally and internally at one and the same time; the movements of the finger which has been introduced into the pharynx being followed by the corresponding finger of the other hand, which is placed upon the external surface of the neck. This method, it will be readily seen, is especially useful in ascertaining the location and extent of deep swellings.

In order to avoid retching and vomiting on palpation of the pharynx, it is necessary at first that the examiner should not prolong the examination. By degrees the patient will become accustomed to the process, and disagreeable as it is to him at first, it can, later, be prolonged until the desired results are reached.

The larynx may be palpated either externally or internally. If internally, the examiner can feel distinctly the laryngeal surface of the epiglottis, the plica ary-epiglottica, and the arytenoid cartilages ; but in consequence of the reflex contractions of the *aditus laryngis*, which follow the introduction of the finger into the cavity, the remaining parts present themselves to the examiner's touch only as indefinite outlines, if indeed he be able to pass his finger that far down.

The larynx is palpated externally in order to ascertain whether pressure be painful, and what sort of fremitus the vibrations of the vocal cords produce through the laryngeal walls. The movements of the larynx should also be observed, and especially the position of the thyroid cartilage in relation to the cricoid cartilage and the hyoid bone. The crepitant noise sometimes heard when the larynx is moved to and fro laterally is caused by the rubbing of the greater cornua of the thyroid cartilage, uncovered by muscular tissue, against the vertebral column.

The points in the larynx and in the nose which the surgeon is unable to reach with his finger, may be palpated by the assistance of a sound (Fig. 12), and the same instrument may be employed to demonstrate the amount of sensibility which given parts possess. In this way we may ascertain not only the degree of reflex excitability, but also the points of greatest irritability. Interference with the larynx causes immediate reflex movements, followed generally by retching and spasmodic closure of the superior strait of the larynx. In the pharynx direct irritation is rarely followed by coughing. In the larynx the true vocal cords appear to be less sensitive than the false cords.

This method of examination, however, is so little practised that but few observations exist throwing light upon the pathological significance of sensitiveness of the pharynx. The method of introducing instruments into the laryngeal cavity will be described hereafter.

EXAMINATION BY AUSCULTATION AND BY THE SENSE OF SMELL.

Besides the senses of sight and touch, those of hearing and smell often offer valuable means of diagnosis to the surgeon in his examination of the parts now under examination. The sense of smell, for instance, will inform us whether the patient's breath is offensive, and if we find this to be the case, it will be our rather unpleasant duty to discover whence the odor proceeds. An affection of the nose is the usual cause. If this be the case, the breath will lose its offensiveness, if the patient close the nose tightly with the fingers, and breathe through the mouth

alone. But, occasionally, it will be found that the smell proceeds either from the decomposing matters in the crypts of the tonsils, or from the secretions of the pharynx, the larynx, etc.; to locate its site, therefore, the surgeon will need to touch the suspected points with a small pledget of cotton or a piece of blotting-paper, which being contaminated by the affected part, will demonstrate the fact most clearly.

The ear is employed for diagnostic purposes in the following manner : If the patient expire forcibly through one nostril —the mouth and the other nostril being kept closed—the fulness of the current of air escaping through a nostril of normal calibre will be readily appreciated by the ear. If the air be not heard to escape under these circumstances, some obstruction in the calibre of the nasal passage in question surely exists. Again, if the surgeon should listen attentively while the patient speaks, changes in the quality of the sound [Klangfarbe— clang-tint] will indicate changes in the adjoint-tube,—the nasal passages,—and impurity of the tone, changes in the laryngeal cavity, especially of the vocal cords. Purity of tone may be interfered with : 1, by alterations in the elasticity, moisture, etc., of the vocal cords ; 2, by insufficiency of force in the column of expired air which strikes them, and should throw them into vibration ; 3, by defective formation of the glottis, which latter may be caused by, a, changes in the configuration of the vocal cords and of their adnexa ; b, paralyses of the muscles ; and, c, mechanical obstacles ; 4, by insufficient tension of the cords ; and, finally, 5, by obstacles which prevent their proper vibration.

If, again, the patient be incapable of pronouncing certain consonants, the surgeon may, by ascertaining to which class these consonants belong, whether labials, linguals, etc., early determine the locality of the lesion. His ear must also inform him as to the character of the patient's cough, which, if a laryngeal affection is present, will usually be hoarse and barking ; and whether the inspired air finds entrance into the lungs without meeting with any obstruction in its course. If there be obstruction, stridor will be produced, which may depend either upon a narrowing of the calibre of the air-passages, upon certain forms of paralysis of the glottis by which it is contracted, or the point

of the arytenoid cartilages is bent forward, or upon spasm of the glottis.

Finally, the patient should be asked to communicate his subjective symptoms, whether he experiences pain on deglutition or in phonation, and whether his sense of smell is affected; and it is only after all these points have been thoroughly investigated that the surgeon can render his opinion in an intelligent manner.

GENERAL THERAPEUTICS.

In considering the subject of the therapeutics of the nasal, pharyngeal, and laryngeal cavities, our intention is to familiarize the reader with those therapeutic means which are not only topically applied to these cavities, but whose remedial action is confined to them. All methods of treatment, therefore, in which the above-mentioned parts are employed as points of application for remedies designed to act at a distance, are omitted, as well as the consideration of any plans of treatment in which remedies are applied to other parts of the body, skin, stomach, etc., for the purpose of acting upon the organs now under consideration.

The only special preparation which is necessary, upon the part of the surgeon, is with reference to the introduction of instruments into the larynx. This procedure, however, not only demands a considerable amount of practice, but also a certain degree of skill, in order that the instrument may be introduced rapidly and safely into the larynx, and applied to the desired point. Not only the surgeon, therefore, who undertakes special and bloody operations upon this part, but every physician who treats patients suffering from the ordinary diseases of the throat, should acquire this necessary skill by long-continued practice. For almost all local therapeutic procedures in the larynx render the introduction of instruments necessary, and this subject, therefore, comes legitimately within the scope of this Cyclopædia, which does not treat of purely surgical procedures.

The larynx was treated locally even in pre-laryngoscopic times. The surgeon either fixed the epiglottis by means of his left forefinger, and then, guided by the sense of touch, carried a sponge-holder into its cavity, or he excited retching or caused the patient to swallow in order to profit by the elevation of the

larynx which followed both acts.[1] It is only, however, since Czermak made the laryngeal mirror a "sure guide for the operating hand," that therapeutic or operative procedures in the interior of the larynx have become safe and sure. He himself cauterized a larynx, with the aid of a mirror, in February, 1859. Since this time the method has come into universal use, opening a safe way into the larynx, so that the old plan of making local applications during an act of retching, when the epiglottis was thus brought into sight (see p. 4) is now only permissible in very exceptional cases, or, if I may be allowed the expression, as a sort of *pons asinorum*.

It is advisable that the introduction of instruments should first be practised upon a dummy, with probes (Fig. 12), before attempts are made upon the larynx itself. The surgeon, holding the mirror in the left hand, introduces a probe with his right, in the median line of the mouth, until he has carried it over the epiglottis, and has entered the laryngeal cavity without touching anything on the way. This procedure can only be learned by practice, and not from descriptions, no matter how detailed, and therefore it will be sufficient at this point to direct the examiner's attention to the following two points which experience has shown to be the most difficult to the beginner. As the laryngeal picture hardly admits of being viewed with both eyes, and as the anterior and posterior parts of the larynx appear, respectively, as upper and lower in the picture, as seen in the mirror (p. 51), it is not easy at first to localize the various parts, or to determine exactly at what point the tip of the sound is applied. Beginners, therefore, usually hold the sound at some distance above the vocal cords, and must be made to introduce it more deeply to the proper point of destination. Secondly, the beginner often fails from not appreciating the short curve which the sound has to describe over the epiglottis to pass into the larynx, and not posteriorly into the œsophagus. To accomplish this it is only necessary for the examiner to elevate his hand, and with it

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[1] *Trousseau* et *Belloc*, Traité pratique de la phthisie laryngée. Paris, 1837. (Medication topique. Médicamens liquides), p. 316. *Rühle*, Kehlkopfkrankheiten. Berlin, 1861, p. 31.

the handle of the instrument, a movement which it is impossible for him to accomplish without raising his elbow.

Although, then, the introduction of a sound into the larynx requires some practice, it is not a matter of witchcraft, but may be learned in a few hours. The surgeon, once having learned to introduce the sound successfully, is prepared to undertake the use of any other instrument, and to conduct intra-laryngeal procedures with an assurance which inspires confidence, and a rapidity which gives the patient no time for reflection, and hardly lets him know that anything has taken place within his larynx until it is all over.

After the laryngeal mucous membrane has been touched, and still more certainly after an application of caustic has been made to it, retching, and occasionally attacks of suffocation occur, the latter being caused by a spasmodic contraction of the *aditus laryngis*, or of the glottis, and generally passing away in a few seconds. It is only in rare cases that the attack appears threatening, and there is no case on record where tracheotomy has been rendered necessary by a spasm of this kind. Calmness, on the physician's part, and a swallow of water given to the patient, have hitherto always been sufficient to overcome it. Water must always be conveniently at hand when instruments are introduced into the larynx, in order that a few swallows may be immediately given to the patient in case an attack of this kind supervenes. Besides the water the surgeon will do well to have a convenient vessel ready into which the patient may spit, or, as sometimes happens, vomit.

Before the special local therapeutic methods are more fully discussed, one or two outside matters, which are of some practical importance, should at least be alluded to. In all cases where applications are used which cause a stain, care should be taken by the surgeon to protect both himself and his patient; this may be done by spreading over his lap and that of the patient, who sits opposite to him, an india-rubber cloth, or a piece of oil-cloth. It is, furthermore, of the greatest importance to insist upon it that, as far as possible, every patient should have his own individual outfit. The danger of infection and the dictates of cleanliness sufficiently explain the necessity for this.

Finally, we may be allowed to remark that no matter how great a value the surgeon attaches to a good armamentarium, less seems to depend upon the invention of new, and the improvement of old instruments, than upon the skilful use and practical application of those which are already known.

Beginners, especially, are more likely to attribute their want of success in an operation to the instrument than to their lack of technical skill, and instead of practising with the old instruments, they impose upon their inventive faculties the unnecessary task of devising new ones, which are to satisfy their excessive demands.

Medicinal substances and solutions are applied to the nasal, pharyngeal, and laryngeal mucous membranes for the following various purposes :

1. To act upon the circulation (astringents) ; 2, to destroy abnormal outgrowths of tissue or induce their retrogression (caustics) ; 3, to promote the reparative process and cicatrization of ulcers ; 4, to abort, to limit, and to reduce inflammatory action ; 5, to reduce or increase the amount of secretion, to alter its character and to neutralize it, disinfect it, etc. In the following pages, however, we shall not divide the subject according to the action of remedies—a division which, *à priori*, would certainly be correct—but shall study the different methods of their use according to the physical characteristics of the means employed.

I. THE APPLICATION OF SOLIDS.

a. *The Simple Direct Method.*

The principal medicaments to be considered under this head are, alum, borax, sulphate of copper, nitrate of silver, mitigated stick of the same, Vienna paste, and chromic acid ; that is to say, astringents and caustics which are easily dissolved, and are designed to be applied lightly to the mucous membranes. The instrument necessary for the application of these remedies consists of a suitable holder, in which pieces of the above-mentioned substances may be firmly held (forceps, crayon holders). If these pieces are rough, they should be smoothed, before being

used, by means of an ordinary file. The application of the weaker remedies to the pharynx may, in case of necessity, be entrusted to the patient himself. The importance of the subject demands that special mention be made of the method in which nitrate of silver is fused upon a flexible wire. The latter should preferably be of silver, but other kinds of wire may also be used. Special instruments have been devised for use in the larynx (Fig. 18), the advantages of which are not to be ignored.
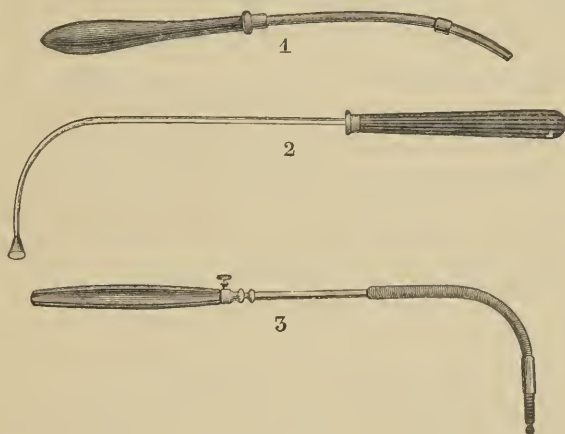

FIG. 18.
Porte-caustiques.
1, Made of hard rubber for the pharynx; 2, rod for fused nitrate of silver; 3, guarded porte-caustique, according to Tobold.

The nitrate of silver is heated over a spirit-lamp, and when beginning to melt is brought into contact with the heated probe, when it adheres to the latter. But in order to ascertain whether this adhesion be firm or not, after the mass has cooled, it is advisable to strike the instrument against some hard object. The whole process is therefore a very simple one, and by means of a suitable probe admits of the application of the nitrate of silver to any part of the region under consideration. It may here be stated, once for all, that all instruments prepared for the larynx may also be used for the naso-pharyngeal space by simply reversing them. In coating a probe with nitrate of silver, this substance is applied either to its end alone or upon its side, the latter having been previously flattened; and, to protect the healthy tissues from the action of the caustic, the remaining

parts of the probe are coated with a paste of meal mixed with common salt. If Vienna paste is used, fat or oil, instead of the salt, will answer the same purpose.

Chromic acid, recommended by Lewin, is applied principally in the pharynx, small crystals being used, which are brought into contact with the desired point by means of small wooden rods. The hygroscopic chromic acid becomes fluid at the point of application, where it causes a superficial necrosis and considerable shrivelling of the tissues. It is an efficient caustic, but its action is so intense that it should be employed only with great caution, and the surgeon will only select it when he desires to cause the rapid and complete destruction of some one small point of ulceration or hypertrophic outgrowth.

In this, as in all other methods of treatment to be mentioned hereafter, a second application is only to be made after the effects of the former one have either begun to subside or have entirely disappeared.

b. *Insufflation of Powders.*

Pulverized substances may either be inhaled by the patient into the region of the body with which we are dealing, or be
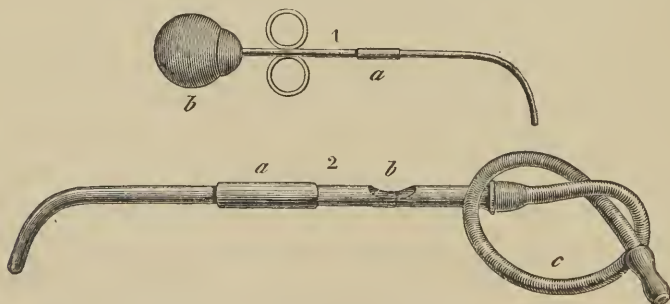
FIGS. 19 and 20.

FIG. 19. Insufflator of silver for the larynx, according to Rauchfuss.

a, Slide, closed over the opening which contains powder; *b*, rubber bulb for the compression of the air and the expulsion of the powder.

FIG. 20. Insufflator of hard rubber for the larynx.

a, Slide, pushed away from the opening, *b*; *c*, tube for blowing in air.

blown in by the surgeon. The first method is still used, for the purpose of making applications to the nose, in the form of snuffs.

It has long since been pretty much given up as a method applicable to the larynx, for which it was recommended by Trousseau and Belloc. For the purpose of insufflating powders, suitably shaped tubes of glass, of hard rubber, or of silver, and, in cases of necessity, a simple goose quill, are employed, being made straight for the nose and pharynx, and curved for the larynx. They must, moreover, be so arranged that they are easily filled with the powder (Fig. 19). I employ those provided with a flexible tube of sufficient length (about twenty inches) and a mouthpiece, so that the operator can expel the powder by blowing (Fig. 20), and prefer them to other instruments in which the same thing is effected by the compression of an India-rubber ball (Fig. 19) attached to the extremity of the instrument. As this compression of the ball has to be effected by the same hand that holds the instrument, the powder can hardly be expelled without some motion being communicated to the point of the instrument, and a localization of the powder is therefore much less certain with this form of apparatus than with the former. On the other hand, the tubes first mentioned are themselves objectionable, inasmuch as they oblige the surgeon to blow into the patient's mouth; and to obviate this objection Bruns produces the requisite current of air by means of bellows placed beneath the foot.

The articles most commonly employed in this way are tannin, nitrate of silver, alum, oxide of zinc, calomel, and sulphur. The amount put into the opening of the insufflator each time is from a grain and a half to four grains. It is therefore desirable to mix the stronger articles (silver, tannin), with the milder (alum, zinc), or with sugar of milk, prepared talc (Bruns), etc., in proportions varying according to the effect desired, and ranging from one part of the former to ten of the latter, to equal parts of the two, with the addition of narcotics (morphine).

To avoid a reverse current, which may be caused by the expiration or cough of the patient, the surgeon should blow the powder into the larynx at the moment of inspiration, or while the patient phonates softly, if it is desirable to prevent it from entering the trachea. The point of the insufflator must be directed towards the point at which the application is to be

made, without, however, touching it. The effect of the application of remedies in this way may be somewhat limited as to area, though by no means to the same degree as in the method just described (cauterization). Insufflation is, however, much more easy of performance. The patient frequently retches and coughs after such an application, but attacks of spasm of the glottis, so easily caused by the contact of caustics, very rarely occur. The method is applicable in the treatment of chronic inflammations, of superficial ulcerations, tumefactions, etc.

c. The use of caustic darts is never attempted in the larynx, and but rarely in the nose and pharynx. Darts of equal parts of iodine and iodide of potassium prepared with dextrine, and made as fine as Carlsbad needles, are used however with success in the treatment of such forms of hypertrophied tonsils as present numerous wide-mouthed crypts.

d. The application of ointments is, as far as the special regions now under discussion are concerned, only available in the anterior nares.

II. THE APPLICATION OF FLUIDS.

a. *Pencilling.*

As fluids may be held by a brush or sponge, it is possible to apply solutions to the nose, the larynx, and especially to the pharynx. To accomplish it the surgeon needs for the pharynx
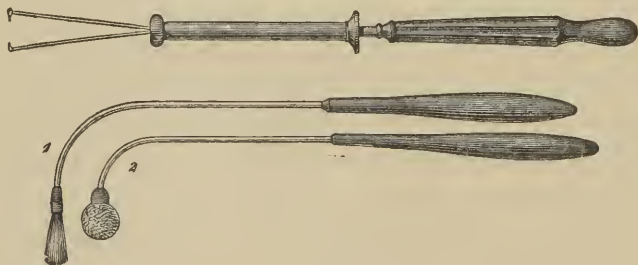
FIGS. 21 and 22.

FIG. 21.—Sponge holder.
FIG. 22.—1. Laryngeal brush. 2. Laryngeal sponge.

a straight pencil, or a sponge-holder (Fig. 21), to which may be fastened a small bit of sponge or a pledget of cotton. The latter

I am in the habit of using exclusively, on account of its simplicity, convenience, and cleanliness. The pledget is prepared according to the size of the part which is to be treated, and is placed between the arms of the sponge-holder and fastened by means of a sliding clamp. After it has been used it may be detached from the holder and thrown away, without touching it with the fingers, by simply drawing back the slide. By means of such an instrument applications can be thoroughly made not only to the pars oralis but also to the pars nasalis of the pharynx, but for the latter purpose it is advisable to fasten the pledget of cotton by a corner alone, and pass it behind the velum. The contraction of the pharyngeal muscles which immediately occurs will then express the fluid contents of the pad.

Special sponge-holders are also constructed for the larynx, but, on account of the serious results which would follow if the sponge were to escape from the grasp of the instrument in this region, it is advisable to use only the special forms of brushes or sponges represented in Fig. 22. The stem of such a holder must not be too flexible, and the sponge or the pencil must be firmly attached to it, so firmly that not the smallest piece, not even a single hair of the brush can fall away and be lost in the larynx. Each patient should have his own instrument, which he may either carry away with him or leave at the office of the surgeon. Before being used the brush or the sponge should be moistened, and it will be found, as a rule, that the brush absorbs less liquid than the sponge. It is therefore preferable, if a small part of the laryngeal surface alone is to be treated, to use a very fine brush. Generally, however, its whole surface is brought into contact with the liquid, as the constrictor aditus laryngis is tightly closed about the instrument as soon as the latter is introduced into the larygeal cavity, and on this account the present method of treatment admits of less local limitation as regards its effects on the tissues than those previously mentioned. By changing the degree of concentration of the solution, the surgeon will find it easy to regulate its effect according to the indications presented. The use of a brush or sponge is more likely to result in staining the clothing, and as the brush is brought into contact with the mucous membrane this method is more disagreeable to

the patient than insufflation. These points, then, will serve to render the advantages and the disadvantages of both the methods described apparent to the reader. I have been unable to discover any difference in favor of either brush or insufflator, after using both alternately in the same case, but the use of the brush cannot be dispensed with, for, in addition to other reasons, many medicaments are made available by its use which can only be applied in solutions.

Water, or water with glycerine, is commonly used as the solvent; but a *linctus*, made palatable by the addition of syrup, may be prescribed, especially for use in the pharynx. In order to avoid waste, only a small quantity of the solution, sufficient for one application, is poured into a small glass, which stands on the right of the surgeon, and into which the brush is dipped until saturated.

The method of introducing the brush into the larynx is the same as that already described, when speaking of the introduction of the laryngeal probe, etc., on page 74.

The medicaments used may be solutions of any of the astringents previously mentioned, preferably nitrate of silver (from ten to fifty grains to the ounce) and tannin (from twenty-five to one hundred grains to the ounce). Besides these we use solutions of the chloride of iron, tincture of iodine (or a solution of iodine in glycerine), corrosive sublimate, bromide of potassium, chlorate of potassa, chloroform, lime-water, alcohol, lactic acid, pepsine, pyroligneous acid, permanganate of potassa, carbolic acid, etc.

b. *Syringing.*

Liquids may likewise be applied to both the pharynx and larynx by means of the syringe. Any form of syringe will answer the purpose for the pharynx, but for the larynx the canula of the syringe must not only have a given form, but must also be so arranged that the fluid will not be discharged too quickly, and the jet not be too powerful. A detailed description of the very many forms of apparatus designed for this purpose is unnecessary, and only those of the simplest construction are shown in Fig. 23. No. 1 represents a syringe of hard rubber,

similar in its construction to that of Pravaz, as used by gyne-
cologists fo rintra-uterine injections, with the exception that the
canula is curved in a direction suitable for entering the larynx,
and that its end is perforated with small openings. Fig. 23, No.
2, shows an instrument of hard rubber, in which the suction is
not performed in the usual manner by a piston, but by means of
an elastic membrane, stretched over a small cup-shaped depres-
sion in such a manner as to make it air-tight. This elastic mem-
brane having been strongly depressed by means of the forefinger,
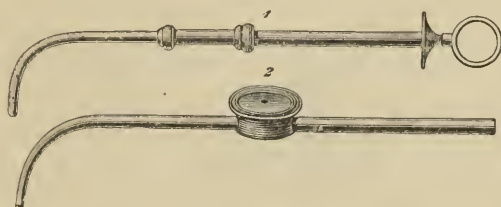the point of the instrument is immersed in the solution to be

FIG. 23.
Laryngeal syringes.

used. When the pressure of the finger is withdrawn, the mem-
brane recovers its former position, and the cup is filled by the
fluid, drawn up into it through the tube of the instrument, and
pressure again upon the membrane, after the instrument has been
introduced into the larynx, ejects it. For the purpose of secur-
ing an exact dispensation, the surgeon may use a graduated
glass, from which to draw up the solution. The same purpose
may be served by the use of simple curved tubes of glass, as
follows : The point being placed in the solution, while the
other end is held tightly closed by the pressure of the surgeon's
finger, the tube is filled by simple removal, for a second, of the
latter. The finger then being again pressed against the end, the
tube may be introduced to the desired point of application in the
larynx, and the contained liquid expelled by simply removing
the finger.

As a rule, but few applications are made to the larynx by
means of the syringe. Besides narcotics (morphine), lime-water
(for diphtheria) is almost the only one.

With the nose, however, the case is different ; its configu-

ration being especially adapted to this method of applying med-
icaments. If liquid under a certain pressure enters one of the
nostrils, the velum is elevated and closely approximated to the
posterior pharyngeal wall, so that the nasal cavity is closed pos-
teriorly in such manner that the fluid running through the pos-
terior nares escapes by the opposite nostril. If the patient's
head be inclined forwards, the liquid, as it runs out, is easily
made to flow into a suitable vessel. It can therefore be readily
understood why this method, which bathes the entire nose and
upper parts of the pharynx, and is at the same time so simple
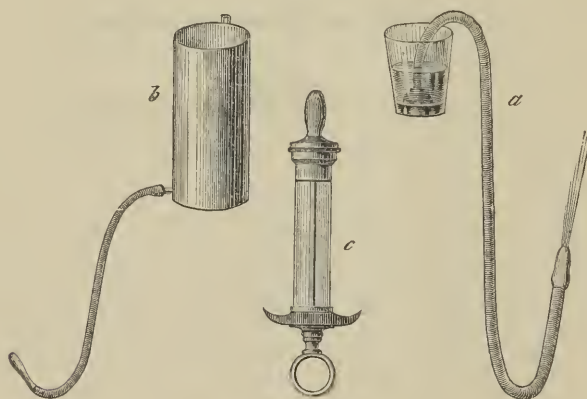and so complete, is preferred to all others. The instruments for

Fig. 24.

a. Nasal douche, according to Th. Weber; *b,* irrigating apparatus for nasal douche; *c,* nasal syringe
according to Weber-Liel.

effecting this injection are either a common syringe, provided
with a suitable nozzle (Fig. 24, *c*), or the so-called nasal douches,
of which one, arranged on the principle of the irrigator, is shown
in Fig. 24, *b.* Fig. 24, *a,* represents the form of douche most
commonly used; it is the one designed by Th. Weber. It con-
sists of a flexible rubber tube, provided at one end with a nozzle,
and attached at the other to a perforated plate of metal, usu-
ally zinc, which is lowered into the water contained in a vessel
placed above the patient's head. Suction upon this latter with-
draws the air contained in the tube, and causes the water to flow
through it, the whole apparatus then acting as a syphon. The
patient himself may withdraw the air from the tube, after having

introduced the olive-shaped nozzle into the nostril, by inspiring through the nose, the opposite nostril and the mouth being closed. The successful use of any of these instruments depends mainly upon the fact whether or not the olivary nozzle is fitted into the nostril in such a manner as to be air-tight. Tröltsch [1] recommends the injection of a liquid mixed with air, for the purpose of cleansing the nasal cavities, and accomplishes this by introducing a suitable tube along the floor of the nostril, through which both air and fluid are propelled in the form of spray.

It has been urged against the use of the nasal douche, that inflammations of the ear are often caused by it, the injected liquid penetrating, in spite of all precautions to the contrary, through the Eustachian tube into the cavity of the middle ear. On the part of others the douche is especially recommended for the purpose of injecting fluids into the Eustachian tubes, a procedure which it is true may readily be accomplished thereby. If, during the application of the douche, the nostril which should be left free, is closed, and the patient make efforts at swallowing, there is no doubt but that fluid will enter the tubes. But this occurrence is by no means as dangerous as has been represented, and is very easily avoided in patients who are not too stupid, by having them leave the nostril free, abstain from efforts at swallowing, and breathe calmly with widely opened mouth. The physician, therefore, at least as far as our present experience goes, need not be deterred by the above consideration from using this most useful apparatus; but in all cases proper precautions must be taken, and as the patient is to use the douche independently of the surgeon's observation, he must previously be carefully instructed as to the proper method to be followed, and in no case be allowed to use too high a pressure.

In lieu of the douche, the patient may cleanse the nasal cavities—with less success, however—by drawing up, or snuffing up, a fluid from the hollow of the hand. It would be far more reasonable to advocate drinking out of the hollow of one's hand, as an improvement on using a cup, for one can drink out of his

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[1] L. c., p. 339.

hand, whereas it is impossible to snuff up sufficient fluid to fill the entire nasal cavity. In contrast to the above is a method of treatment pursued recently by Friedel,[1] in three cases of ozæna. It is worthy of attention, and is described as follows :

The tamponing of the posterior nares was performed first on the right side, and the following day upon the left, with pledgets of lint of the thickness of one's thumb, saturated with carbolized oil. The patient was then placed in a horizontal position, and while the head was thrown so far backwards that the nostrils lay in an almost horizontal position, the nasal cavity of the side that was plugged was filled with a solution of carbolic acid (one per cent.). The corresponding nasal orifice was then closed by means of a bit of punk. The disinfecting solution was thus kept in contact with the diseased membrane as long as the patient could tolerate his position. After twenty-four hours the posterior plug was removed through the anterior naris, and it was found that the odor had almost disappeared from the nostril treated. The opposite nasal passage was then plugged, treated in the same way, and with the same result. In the meantime the douche was applied to the free side of the nose, and although the following day it was not entirely free from disagreeable odors, the offensive smell diminished steadily. Later on, carbolized glycerine was used instead of the oil, and the nasal cavity filled with it as described, until the production of crusts and bloody pus ceased. A fifty-grain solution of sulpho-carbolate of zinc was then used to fill the cavities, and also as a douche. The duration of the treatment—requiring the patient to lie upon his back for ten days—should not prevent a further trial of this method, which promises success in this class of cases, so tedious and almost desperate.

The following medicaments are commonly employed in the douche : 1. As astringents : alum, tannin, nitrate of silver (a five-grain solution). 2. As resolvents, and to remove hypersecretion : chloride of sodium, carbonate of soda, muriate and carbonate of ammonia. 3. As disinfectants : permanganate of potash, solution of chlorinated soda, carbolic acid, carbolate of

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[1] Deutsche militärärztliche Zeitschrift, 1873, p. 533.

soda, sulpho-carbolate of zinc, etc. As solvents and emollients: water, glycerine, infusion of chamomile, and remedies of a similar nature. For hay-fever: quinine (a grain to the ounce). For diphtheria: lime-water, etc. The dose of the simpler drugs varies from one part to two hundred to three parts to one hundred. The use of pure water is to be avoided in the douche on account of the swelling of the nasal mucous membrane which it causes. If the application of cold be not indicated, the temperature of the fluid used in the douche may be regulated according to the feelings of the patient, generally varying from 77° to 95° Fahr.

The application of solutions is still further extended by the use of the so-called gargles—a method of treatment which is familiar to every one, and convenient, because, except in children, it is thoroughly understood by the patient. But the space which is medicated by them is circumscribed, and invariably limited to the *pars oralis pharyngis*. Tröltsch,[1] however, recommends another method of gargling, which is much more efficient. In performing it the patient is required, while sitting or lying with the head inclined as far backwards as possible, to pass a large mouthful of the prescribed solution as far back into the throat as possible, while, at the same time, movements of deglutition are made, without, however, allowing any of the fluid to enter the œsophagus. It will at once be seen that this process brings the gargling fluid much more extensively into contact with the mucous membrane.

The medicaments which may be used for the purposes of gargling are the same as those already prescribed for use with the brush, or those used for purposes of inhalation, to be mentioned directly. The dose is usually double that used internally. The danger of absorption, and of swallowing the solution, renders it unadvisable to employ them in a stronger form, and if, therefore, the surgeon desires to use more powerful solutions than those cited above, he must depend upon one of the other methods of application which have been described.

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[1] L. c., p. 343.

INHALATION OF ATOMIZED FLUIDS.[1]

In the year 1858, Sales-Girons described, under the name of "Pulverisateur des Liquides," an apparatus by means of which a fine jet of water could be thrown against a flat surface with such force as to transform it into a fine spray, which could without difficulty be inhaled deeply into the bronchiæ. Such a decided impetus was given to the treatment of the diseases of the respiratory organs by the discovery of this apparatus, that the subject soon attracted universal attention, a special literature rapidly collected, and many different forms of apparatus were speedily devised. All of the latter, however, with the exception of the one which has already been described, may be divided, for purposes of consideration, into three groups, as follows :

1. *Principle of Matthieu.*

Air is compressed in a tightly closed vessel which contains the liquid medicament ; escaping then through a small opening, it meets with the liquid which has been driven by compressed air through a narrow tube ending at the same point with the opening just mentioned, and here a fine spray is necessarily produced.

From the large list of apparatuses constructed on this principle, the syringe of Schnitzler [2] alone is selected for the purpose of illustration, and shown in Fig. 25, although Lister's apparatus, belonging to the same class, might be used for a similar purpose.

By means of a rubber balloon attached at *a*, air is forced into the cylinder *b*, and its contained liquid caused to rise through the tube *c* into the common tube *d*, through which the tube *c* passes to its point. In the common tube *d* there is likewise a channel for the passage of the compressed air, which finally

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[1] *Waldenburg*, Die locale Behandlung der Krankheiten der Athmungs-organe. Berlin, 1872. *Lewin*, Inhalationstherapie. Berlin, 1865. *Siegle*, Bchandlung durch Einathmungen. Stuttgart, 1865.

[2] Wiener medicinische Presse, 1871, p. 791.

escapes at its point, meeting with the fluid and ejecting it in the form of a fine spray.

This apparatus is easily managed and is very efficient.

2. *Principle of Bergson.*

Compressed air is forced through the small orifice of a tube which is met at its point by a second tube, with an equally small orifice, arranged at a right angle to the first, the lower end of the latter being immersed in the solution to be atomized. The strong current of air passing through the first tube, and over the mouth of the second, causes a current in the latter, which carries the fluid upward and out at the point where it is transformed into fine spray by the strong current of air which strikes it. This principle is the one which is so commonly made use of, not only for medical purposes, but also in the so-called "rafraîchisseur." Fig. 26 shows the form of the original apparatus of Bergson, and Fig. 27 represents the modifications introduced by Wintrich, which permit the introduction of the instrument into the mouth of the patient, and the production of the spray there. Weber-Liel [1] has constructed an apparatus upon the same principle, which has received the name "Coniantron," and by means of which the point of the instrument is introduced into the *pars nasalis pharyngis*, and held there while the contained fluid is atomized. This apparatus also admits of an exact dispensation of the given drug or amount of solution. The same purpose may, however, be effected by means of Wintrich's apparatus, if the tubes be made of a thin and flexible metal, so that they may be turned upwards; but, except in the case of the nasopharyngeal space, little is to be gained by advancing the point of the instrument beyond the opening of the mouth.

The motive power for the apparatuses of both groups is generally obtained by means of an india-rubber bulb, which, after

FIG. 25.
Schnitzler's Inhalation Apparatus.

a, Joint for the attachment of the balloon: *b*, cylinder of glass, closed at the ends by hard rubber caps; *c*, tube which passes below the level of the contained liquid: *d*, common tube, which is removable, in order to allow of the cylinders being filled with the medicated solution.

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[1] Deutsche Klinik, 1867, No. 51.

compression, expands again by its own elasticity. This bulb is arranged with valves, so that during its compression the contained air escapes only at one end, and immediately enters at the other when the pressure is removed. In order that a con-
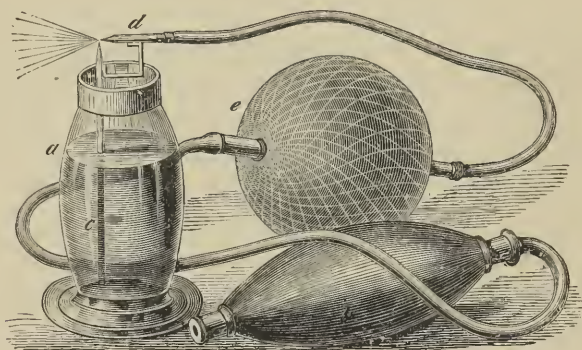

FIG. 26.
Bergson's Hydrokonion.
a, Bottle; *c*, tube in which the fluid rises; *d*, air-tube; *b*, rubber-bulb; *e*, rubber-ball, serving as a reservoir.

tinuous current may be produced, the air ejected by the first bulb passes into a second one, covered with netting, which serves as a reservoir, and for the purpose of compression either
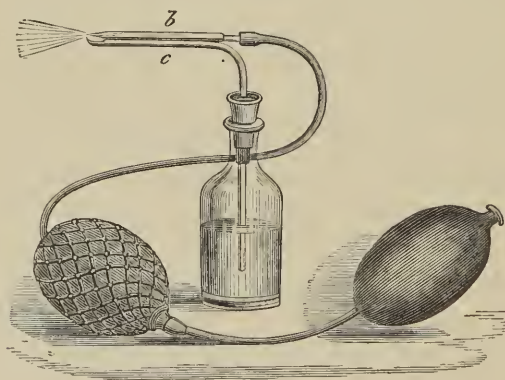
FIG. 27.
Wintrich's Hydrokonion.
b, Air-tube; *c*, tube for fluid.

the hand (Fig. 27) or foot (Fig. 26) may be used. If expense is no object, an air-pump may be attached to the apparatus,

instead of the hand balls, an arrangement which will spare the surgeon the necessity of using either his hand or his foot, and which will only need to be worked at intervals.

3. *Siegle's Principle.*

Instead of compressed air Siegle employs steam under pressure, generated by means of a spirit-lamp. His original apparatus is figured in cut No. 28, and the modifications of it, traceable to several authors, are shown in Fig. 29. The original apparatus consisted in a jar of glass (*a*) closed by means of a perforated rubber cork, in one of the openings of which was placed a thermometer (*t*), to register the pressure of the steam contained in the jar, and to indicate when there was danger of an explosion. In the second opening was a glass tube (*b*) for the purpose of conducting the steam jet to the point of the instrument, where it met the perpen-

dicular glass tube (*c*), the lower end of which was immersed in the medicated solution (*d*). The whole apparatus was placed in a lantern-like covering made of white metal, designed to protect the patient in case an explosion occurred in spite of all precautions to the contrary. In the modified apparatus, the boiler (*a*) and the steam tube (*b*) are made of metal, while at (*v*) a safety-valve is attached. This latter, from motives of false economy, is found wanting in some
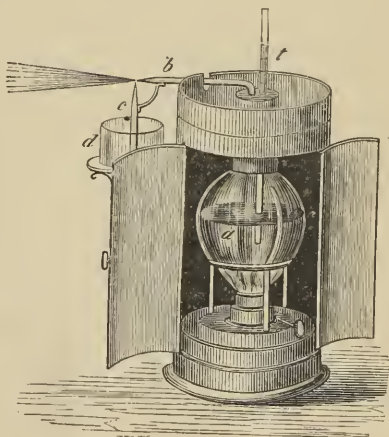

FIG. 28.
Siegle's steam atomizer.

of the apparatuses which are sold. A valve, however, is essential, for although a very rare occurrence, still occasionally an apparatus unprovided with a valve explodes, and damage is done. The screw (*e*) closes the opening through which the water is introduced into the boiler. The boiler is to be two-thirds filled with warm water. After sufficient pressure of steam has been

produced in the boiler by means of the spirit flame beneath it, it passes out through the tube (*b*) over the point of the tube (*c*), and at first causes an upward current of air, then an ascension of the fluid in the latter; finally, the meeting of the steam jet and the fluid at this point causes an atomization of the latter, accompanied by a peculiar hissing noise, which shows that the apparatus is in good working order. Failure will depend upon one of two things, either that the heat of the flame is not sufficiently intense, or that the position of the tube (*c*) is not correctly adapted to that of the tube (*b*), that is, it is either not on the same vertical plane as the latter, or stands at too great a distance from its point.

The steam atomizer differs in its practical application from the apparatuses of the first and second groups in the following points:

1. It produces a warmer spray.

2. The spray is expelled with less force.

3. The degree of dilution of the medicated fluid cannot be exactly determined.

The steam apparatus, therefore, is adapted for purposes of treatment in affections of the lower respiratory passages, while in the apparatuses of the first group the effect of the application is limited exclusively to the pharynx and larynx. The arrangement of the hand apparatus, moreover, renders it desirable, if not necessary, that the requisite current of air be produced by some other person than the patient. The use of this instrument is, therefore, specially adapted to the hands of the physician, particularly in those cases where we wish to direct a powerful
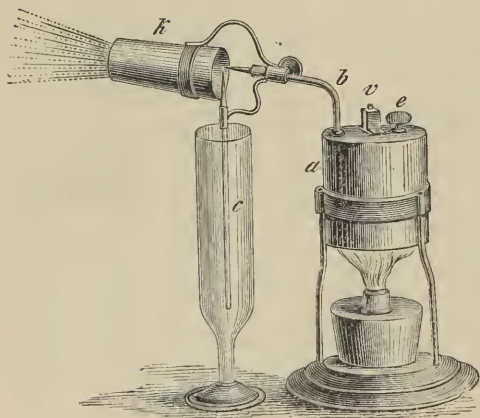

Fig 29.
Steam atomizer.

stream of spray against the posterior pharyngeal wall, in order

to produce anæsthesia, for instance. With any of the forms of apparatus the jet of spray strikes the posterior pharyngeal wall with considerable force, thoroughly bathing it, and is so broken up there that, with the aid of deep inspiratory efforts on the part of the patient, it penetrates into the laryngeal cavity. Its effect is, however, mild, and the atomizing apparatus may therefore be used in cases of recent inflammation ; a localization of effect is, however, unattainable.

The method of using the apparatus is simple : the patient allows the current of atomized fluid to enter his widely opened mouth, and favors its further progress by inspiring quietly and deeply, and by keeping the tongue as closely as possible upon the floor of the mouth. The atomizer is so placed that the plane of the stream is the same as that of the mouth, when the patient sits in a straight but easy position. Children may be held in the proper position, and screaming will only facilitate the procedure. The whole matter, then, is so simple, and is usually so quickly and so thoroughly understood by the patient, that, as the apparatuses are only of a moderate cost, the treatment may be intrusted to the patient himself, and it is hardly necessary that the surgeon should now, as heretofore, carry it out at his own office.

According to the form of apparatus which is used, the time devoted to inhalation at each sitting will vary from two to twenty-five minutes—from one-sixth of an ounce to an ounce or more of the medicated solution being employed during this time.

Patients not infrequently complain that, "in spite of all inspiratory effort" on their part, the amount of liquid in the glass does not diminish, when the steam inhalation apparatus is used. This is usually true, and the reason lies in the fact that the fluid, after condensing upon the glass cylinder (Fig. 29, k), which is used as a mouth-piece, flows back into the glass (c), which contains the solution. It may, however, be prevented from so doing by changing the position of the cylinder or glass, or covering the latter with a piece of paper, arranged so that the fluid will flow off it.

The inhalations may be taken by the patient either once or several (from two to four) times daily, and in some cases—for

instance, in diphtheria—they may be given at intervals varying from half an hour to an hour or two hours.

The medicaments for inhalation can only be used in the form of solutions, preferably made up with water, and are usually prescribed in a concentrated form, to be diluted for use from one-third to one-tenth. The milder remedies may be prescribed in the form of a powder, and the solution prepared by the patient himself. High concentration of a solution is unadvisable, for the desired effects of the application do not correspondingly increase with the grade of concentration, and the inhaled medicated spray is, to a great degree, absorbed by the mucous membrane, and reaches healthy parts as well as those diseased.

The following table, arranged by Waldenburg, presents the various medicaments commonly used for purposes of inhalation, together with the dose:

1. *Astringents* (to be used as cold as is practicable).

Alum............. gr. 1 to gr. 12½ to the ounce of water. ⎫ As styptics, to be
Tannin........... gr. 1 to gr. 15   "   "   "   ⎪ used in stronger
Liq. ferri chloridi [1]. ℳ ¾ to ℳ 9   "   "   "   ⎬ solutions, as high
Nitrate of silver... gr. 1/10 to gr. 5 "   "   "   ⎪ as gr. 25 to the
                                                           ⎭ ounce.

2. *Resolvents* (warm, or lukewarm).

Chloride of sodium........... gr. 1 to gr. 15 to the ounce of water.
Muriate of ammonia.......... gr. 1 to gr. 15   "   "   "
Carb. of soda (pure)......... gr. 1 to gr. 10   "   "   "
Carb. of potassa (pure)....... gr. 1 to gr. 10   "   "   "
Bicarb. of soda (impure)...... gr. 1 to gr. 15   "   "   "
Chlorate of potassium........ gr. 1 to gr. 10   "   "   "
Bromide of potassium........ gr. 1 to gr. 15   "   "   "

(Also as an anæsthetic.)
The mineral waters of Ems, Salzbrunn, and Weilbach.

3. *Narcotics.*

(Here the entire amount of fluid to be inhaled is to be determined on, and as much of the narcotic added thereto as would

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[1] Corresponding to the "strong solution of perchloride of iron" of the British Pharmacopœia.

be given internally   Usually, however, narcotics are only used in small doses, added to other remedies.)

Morphine, tincture of opium, cherry-laurel water, stramonium, hyoscyamus, belladonna in infusion or tincture.

4. *Alteratives, Disinfectants.*

Carbolic acid.................. gr. $\frac{1}{2}$ to gr. 5 to the ounce of water.
Iodide of potassium........... gr. 1 to gr. 25   "   "   "
    Also with an addition of pure iodine of gr. $\frac{1}{20}$ to gr. $\frac{1}{2}$.
Chlorine water................ ℳ 5 to ℳ 50 to the ounce of water.
Liq. sodæ chlorinatæ.......... ℳ 2 to ℳ 25   "   "   "
Permanganate of potassa....... gr. $\frac{1}{2}$ to gr. 5   "   "   "
Sulphate of quinia............ gr. $\frac{1}{10}$ to gr. 1 (in whooping-cough) to the ounce of water.

Against Diphtheria.

Lime-water, pure, or diluted with eight parts of water ; also with the addition of solution of soda or potassa, ℳ 12 to 300 to the ounce.

Carbonate of lithium......... gr. 1 to gr. 10 to the ounce of water.
Lactic acid .... gr. 20 to gr. 50   "   "   "

Against Syphilitic Affections.

Corrosive chloride of mercury... gr. $\frac{1}{10}$ to gr. 1 to the ounce of water.

Aside from this, as *emollients* or *solvents*, infusions of elder, of chamomile, or of linden are used, as well as the guaiac solution and glycerine.

In every case the surgeon should carefully note how rapidly the apparatus used converts the solution into spray, and what degree of dilution it undergoes during the process.

The various methods having now been fully detailed, by means of which the larynx, pharynx, and nares are medicated, the surgeon must be guided by his judgment, and the indications presented in each individual case, in selecting the appropriate means of treatment, for he will find that the method pursued in one case is often totally inapplicable in a second, and that, especially in chronic cases, frequent changes are advisable ;

and although he may thereby seem to be acting inconsistently, he will find that he will accomplish his purpose sooner than if he adhere to one procedure alone, as the only practical and infallible one.

In addition to the method alluded to above, the following two are occasionally used in special cases.

First. The inhalation of gases, such as bromine in diphtheria, and "Brand's remedy" for coryza (*Schnupfenmittel*). In both, the fluid is poured upon a sponge placed within a simple paper cone, which is held either under the nose or before the mouth, and the vapor inhaled. The formula of the latter remedy (olfactorium anticatarrhoicum) is: carbolic acid, eighty grains; alcohol, half an ounce; water of ammonia, eighty minims; distilled water, one hundred and fifty-four minims; and of the former, equal parts of a ten-grain solution of bromine and bromide of potassium. I myself have not been convinced of any special virtue in these methods, although the remedy of Brand is highly spoken of by several authors.

Respirators, especially those prepared by Bäschlin of Schaffhausen, may also be used for the same purpose. They are so arranged as to enclose a sponge or tampon, which is saturated with certain solutions (carbolic acid), and are worn so as to render the inhalation of the gaseous vapor constant.

Secondly. Submucous injections, which are used, first, in cases of hypertrophied tonsils; a solution of iodide of potassium, of iodized glycerine, or of tincture of iodine, being injected by means of a syringe such as is shown in Fig. 23, which is provided with a fine canula needle; and secondly, in the neuroses of the larynx, and for inflammatory pain—in the latter cases morphine being employed.

Recently I have employed this method in a few cases to test the efficacy of carbolic acid as an antiphlogistic, but have arrived at no definite results as to the value of the treatment.

Both cold and heat are applied as well to the larynx and pharynx as to other regions of the body, and the apparatuses of both the first and second class, if used with ice-cold water, answer a most excellent purpose as refrigerators.

A more detailed description of the application of electricity,

for the various forms of paralysis of the muscles of the vocal cords, is necessary. This method of treatment owes much of its perfection to the labors of v. Ziemssen.[1]

Either the constant or the interrupted current may be used either externally or within the pharynx, the electrodes being
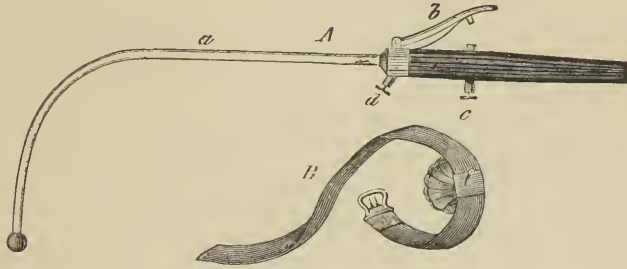

FIG. 30.

Mackenzie's Intra-laryngeal Electrode.

A, Electrode; a, copper sound covered by a catheter; b, small spring which closes the circuit; c, screw for the purpose of attaching one pole of the battery, with the intervention of the circuit closer; d, screw to attach the same directly, without the circuit closer.
B, Collar to which the second pole of the battery is attached.

placed, in the former method, laterally over the lower cornua of the thyroid cartilage, so as to reach the recurrent laryngeal nerve. As a rule, this plan is first undertaken in the treatment of a case, as being the easiest. To act directly upon any one muscle of the larynx, however, with the exception of the crico-thyroid, which from its superficial location is readily reached externally, the laryngeal electrode must be employed, prefer-ably that of Mackenzie (Fig. 30). After the introduction of the instrument into the larynx, with the aid of the mirror, the circuit is closed by depressing the small spring upon its handle (b), while the other pole is held at the same time externally over the recurrent nerve, either by the patient, by an assistant, or by means of the collar shown in Fig. 30, B.

Ziemssen has carefully located the points at which the laryn-geal electrode must be applied, in order to act directly upon certain muscles, as follows: The thyro-arytænoideus is reached from the interior of the laryngeal cavity, and the remaining muscles of the glottis, from the recessus pharyngo-laryngeus;

[1] Die Elektricität. Berlin, 1872, p. 262.

the inter-arytænoideus, posteriorly, behind the arytenoid car-
tilages; the crico-arytænoideus posticus, laterally and somewhat
deeper in the sinus pyriformis; and the crico-arytænoideus late-
ralis, quite laterally, and near the superior border of the cricoid
cartilage.

The galvano-caustic treatment for chronic pharyngeal catarrh,
which has recently been strongly recommended by Michel,[1] needs
a more prolonged trial before a decided opinion as to its prac-
tical results can be formed.

The tamponing of the posterior nares—a procedure which
stands on the border line between internal medicine and surgery
—is undertaken both in the treatment of hemorrhage from these
parts and in the method of
treating ozæna as described by
Friedel, and mentioned above.
The only instrument which is
necessary for the purpose is
the catheter tube of Belloc
(Fig. 31, A), or the Rhineuryn-
ter. Belloc's tube is intro-
duced along the floor of the
nose until the pharynx is
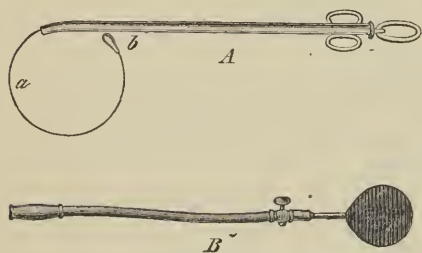
FIG. 31.
A, Belloc's tube; B, Rhineurynter.

reached; the spring, a, is then advanced, and after passing
around the velum, appears in the mouth. A thread attached to
the tampon is passed through the small eye in the button b, at
the end of the spring, and the latter is now withdrawn; then
the instrument and the thread hang from the nostril of the
patient. By means of it, finally, the tampon is passed up into
its position in the posterior nares.

The Rhineurynter, or the Rhinobyon,[2] is a simple rubber
balloon, inflated by means of a flexible tube, provided with a
stopcock, which is attached to it. The apparatus is introduced
into the nostril while empty, then inflated and maintained full
by closure of the stopcock.

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[1] Deutsche Zeitschrift für Chirurgie, II. Band, p. 154.

[2] With regard to its history compare *von Bruns*, Berliner Klin. Wochenschrift,
1871, No. 31.

DISEASES OF THE NOSE.

FRAENKEL.

DISEASES OF THE NOSE.

INTRODUCTION.

DISEASES of the nasal cavity, in spite of the frequency of
their occurrence, belong to a class which has hitherto been made
the subject of very little accurate investigation. Until within a
very short time *clinical observation* has been rendered entirely
illusory by the fact that no method of examination was known
which could give reliable information with regard to the nasal
mucous membrane and the parts adjacent. The discovery of
rhinoscopy, and the advance which has of late been made in
viewing the cavity of the nose from in front, have indeed begun
to throw some light upon the subject. But even at the present
day the entire nasal cavity is not accessible to the eye of the
explorer, and as the only other positive diagnostic means at our
command is palpation, which is only practicable within a limited
area, our knowledge with regard to diseases of the nose com-
pares very unfavorably with the advances that clinical observa-
tion has made in almost all other regions of the body.

Here, too, pathological anatomy has done but little in sup-
port of observations by the bedside. This is owing to two
circumstances : First, that diseases of the nose very seldom lead
to death, and therefore the attention of those conducting autop-
sies is hardly ever called, primarily, to the condition of the
interior of the organ. But, secondly, inspection of the nasal
cavity is seldom possible, even on the dead body. If disfigure-
ment of the face is to be avoided, but a small portion of the
cavity can be exposed, and this only after great labor and care,
with the assistance of a compass-saw and chisel. The only
corpses, therefore, in which the entire nasal cavity can be
examined, are those which no one claims, and in which the

features may be destroyed. At all events, an inspection of the
nasal cavity does not belong to the ordinary course of official
autopsies.

Owing to these circumstances our knowledge of the processes
of disease, and the morbid anatomy of the nasal cavity, remains
quite fragmentary. · We have thought it necessary to make this
statement, by way of introduction, both to avoid the necessity
of frequently recurring to it, and as an incentive to those who
may have an opportunity to enrich our knowledge of the dis-
eases of this region, by all means to improve every opportunity
that offers.

Those diseases of the nasal cavity which belong to internal
medicine, alter the secretion of its mucous membrane and dis-
turb its function, which consists essentially in serving as the
organ of smell and as part of the air-passages. In the latter
capacity it is connected with the sense of hearing and with
speech. We have preferred, instead of giving a general symp-
tomatology, to describe the disturbances accompanying each
disease when treating thereof, but we shall group together,
in one general section, those manifestations which result from
closure of the nasal cavity.

For the same reasons we have not collected the literature of
the subject in one group, but have referred to it at the various
points where its assistance might be required. Diseases of the
nose, as a whole, have been treated of particularly by Fried-
reich [1] and by A. Duchek. [2] Both these authors give an abstract
of the literature.

We hope that the essentially practical considerations which
have determined us to follow this arrangement will not be dis-
approved.

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[1] Virchow's Handbuch der Pathologie u. Therapie, V. Bd. 1 Abth. Erlangen, 1865.
[2] Handbuch d. spec. Path. u. Therap., I. Band, 2 Lief. Erlangen, 1864.

STENOSIS AND ATRESIA OF THE NASAL CAVITY.

Symptoms.

Narrowing and closure of the nasal cavity are conditions that accompany various processes to be described hereafter, as well as other diseases, and the symptoms of which, owing to their clinical significance, we have thought it best to study as a whole.

In the normal state of things *the air drawn in, through the inspiratory movements of the ches , passes through the nose,* the mouth remaining closed. The majority of men do not open their mouths, while awake, in order to satisfy the ordinary demand for breath, though many sleep with their mouths open. But even when the mouth is open, the nose, if in a healthy state, gives passage to the greater part of the air used in respiration. The entering current of air is comparatively small in diameter at the nostrils, and presses chiefly along the inferior nasal meatus and the space between the inferior turbinated bone and the septum, towards the nasal portion of the pharynx, passing behind the relaxed dependent velum into the larynx and the respiratory organs proper. It returns by the same route, in expiration, and it must be taken for granted that with every inspiration and expiration all the air within the nose is set more or less in motion by the current, whose main direction has just been described. In case of an increased demand for respiration, the ordinary avenue, through the nostrils, is insufficient ; it is therefore enlarged, during inspiration, by the action of the levatores alæ nasi—an appearance that may be taken as a sign of dyspnœa—and the mouth also assists as an air-passage.

If, then, the main cavity of the nose is closed, or so far narrowed that its calibre is insufficient for the passage of the air required in respiration, the patient is obliged *constantly to breathe through his open mouth instead of through his nose.* The conditions of respiration are hereby materially altered for the worse. In its somewhat retarded passage over the ever-moistened turbinated bones of the nose, the air grows warmer,

and reaches the deeper respiratory passages charged with an increased amount of moisture. Furthermore, the changes in the direction of its movement, which the current of air undergoes during its passage through the nose, naturally causes a portion of the dust-like particles floating in it to be deposited on the extensive surface of the nasal mucous membrane.

Any one can easily convince himself of this, on blowing his nose after an evening spent at a ball, by observing, on his handkerchief, the number of such particles retained, which would certainly be more injurious to the lungs than to the nose. When the nasal cavity is closed, therefore, *the air conducted to the lungs is drier, cooler, and more unclean.* Hence we see the importance to respiration of habitually breathing through the nose, and the disadvantages resulting from habitual stenosis of this organ. A foretaste of this may also be experienced by those who habitually breathe through the nose, if they are obliged to speak aloud for any considerable length of time. The dryness of the mouth and throat which ensues is an evidence that these parts are less adapted to the immediate contact of the comparatively dry external air. It is evident, from what has already been said, that permanent closure of the nose—an organ, the respiratory significance of which is indicated by the fact that it is peculiar to those animals alone which breathe the air— must result both in disturbances of the respiratory organs and in derangements of the quality of the blood, and of nutrition generally.

These disturbances reach a particularly high grade *when closure of the nose occurs in infants at the breast.* Rayer[1] and Billard[2] first directed attention to the dangers that threaten a nursling when it is unable to breathe through the nose, a condition which may arise from a simple "cold in the head." As the child is obliged, for its proper nourishment, to suck with the mouth for a long time, the difficulty of breathing, due to closure

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[1] Note sur le coryza des enf. à la mamelle. Paris, 1820.

[2] Traité des maladies des enfants, 2d edit., p. 480.

Compare also *Barthez* and *Rilliet*, Maladies des enfants. Paris, 1861, p. 187; and other text-books on diseases of children, especially *Kussmaul*, Zeitschrift f. rationelle Medicin, 1865, p. 225.

of the nose, is greatly aggravated by every attempt to take the breast, soon reaching the point of suffocation, and obliging the child to quit hold of the breast almost as soon as it has commenced, for the sake of getting its breath. In this way such obstacles are interposed to the proper nourishment of the infant that the most serious danger to life may result from this apparently insignificant difficulty.

Aside from the act of suckling, however, *asthmatic attacks* occur in nurslings when their noses are obstructed, because *during sleep they breathe exclusively through the nose.* Kussmaul, in the work already referred to "On the Coryza of Nurslings," communicates some observations that were made by his assistant, Honsell, in the Freiburg Clinic, on the position of the tongue in new-born children during sleep, and on the part which the mouth plays as an air-passage during breathing. It appears from these observations, the results of which I can confirm, that in healthy infants the mouth is almost always closed during sleep (296 times out of 328 observations), and the tongue lies in contact with the hard palate. More rarely the mouth is open, but the tongue still kept in contact with the hard palate, and most rarely (13 times out of 328 observations), is the mouth open and the tongue not thus in contact. In all cases, however, the mouth takes no part as an air-passage in breathing during sleep. It is thus easy to understand that little children are obliged to acquire the habit of breathing through the mouth during sleep, and that, therefore, if occlusion of the nose takes place, they are seized with severe dyspnœa as soon as they go to sleep, the tongue not yet having learned to abandon its physiological position of resting against the hard palate. Thus we can explain the asthmatic attacks of children during sleep, the occurrence of which, during coryza, though rare, has been noticed by children's physicians, and which, as was intimated by even so old a writer as J. P. Frank,[1] threatens the lives of the little ones by robbing them of the possibility of refreshing sleep.

Kussmaul, moreover, draws our attention to another expla-

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[1] Behandl. d. Krankht. d. Menschen, aus dem Lateinischen. Mannheim, 1797, V., p. 102.

nation of these suffocative attacks, viz., that in nurslings suffer-
ing from coryza vigorous attempts at inspiration, while nursing
or asleep, which are rendered futile by closure of the mouth and
nose, may sometimes give rise to very acute *hyperæmia of the
lungs*.

Bouchut,[1] and, before him, Stammer[2] also called attention to
the fact that suffocative attacks in children, under these circum-
stances, might also be accounted for in another way. According
to these authors, the inspiratory movements may become so
violent that *the tongue*—which in the cases described was but
loosely attached, through the frenulum, in front—*is swallowed*,
as we often find it to be during anæsthesia, and, as we would
add, probably closes the respiratory passage by pressure of the
epiglottis against the entrance of the larynx.

These attacks are certainly deserving of all attention, if for
no other reason, because, as described by Henoch,[3] they re-
semble spasm of the glottis, on superficial observation, by their
sudden advent and a certain whistling breathing produced in
the nose. Hauner[4] also states that such cases have been mis-
taken for and treated as true croup.

Even *in adults*, under certain circumstances, closure of the
nose may give rise to *attacks of asthma, or even of positive
asphyxia*. Thus Traube[5] describes two cases in which asphyxia
in adults was due to the fact that with every inspiration the alæ
of the nose (the only point in the passage of the inspiratory
stream of air which is not prevented from falling together by the
presence of cartilage or some other resisting tissue), instead of
dilating, as is the rule in dyspnœa, were pressed together.
Nasal stridor ensued, a phenomenon which Traube attributes
to the beginning of paralysis of the respiratory nervous sys-
tem, and to which patients usually succumb within twenty-four
hours, unless properly treated.

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[1] Traité prat. des maladies des nouveaux-nés, etc., 5. édit. Paris, 1867, p. 237.

[2] Ein Fall vom sog. Verschlucken der Zunge, mitgetheilt von Dr. Droste, in Osna-
brück, in Casper's Wochenschrift, February, 1834.

[3] Beiträge z. Kinderheilkunde, N. F. Berlin, 1868, S. 124.

[4] Jahrbuch f. Kinderheilkunde, 1862, V. Jahrgang, S. 73.

[5] Verhandlg. d. Berl. Med. Ges., 1869–71, II., S. 141.

One of these patients was suffering from pneumonia, and the other from paralysis
ascendens.   Traube does not tell us why they could not breathe through the mouth.
In the first case he mentions that the patient breathed with his mouth shut; in the
second, that he had not for a long time been able to talk nor to protrude his
tongue.

In a similar case which I observed in a child with meningitis, the mouth was
open, but was occluded by the tongue pressed against its roof.

But, aside from these hindrances to respiration through the
defective working of the levatores alæ nasi, *tumors of the nose
are accompanied by asthmatic attacks ;* for which we cannot, as
yet, give any sufficient explanation.   As far as I know, Volto-
lini was the first who called attention to the connection between
nasal polypi and asthma.   He describes two cases [1] (amongst
several which he claims to have observed, in some of which there
was not complete closure of the nose), both occurring in men, one
thirty-three and the other forty years of age, in whom repeated
asthmatic attacks, usually occurring at night, were cured,—that
is, they disappeared, after the removal of numerous polypi from
the nose.   In one of these cases there was emphysema present,
which Voltolini regards as the result of the hindrance to respira-
tion due to the obstructed nasal breathing.   I myself have seen
two cases in which *nocturnal asthma* of long duration disap-
peared after the removal of nasal polypi.   In these cases, both of
which were men of about forty years of age, there was no other
explanation for the asthma except the closure of the nose, espe-
cially no emphysema nor difficulty of the heart.   In both cases
the patients waked up at night with difficulty of breathing, were
obliged to leave their beds or sit up, and after being awake a
little while the asthma left them.   On going to sleep again, how-
ever, the dyspnœa would soon return, and thus they were obliged
to get up repeatedly every night, suffering thereby no little dis-
comfort.   I have been able to offer no other explanation of these
phenomena than to suppose that, during sleep, either an accu-
mulation of mucus in the mouth, or closure of the lips, or pres-
sure of the tongue against the hard palate, or even the relaxed
hanging down of the soft palate, closed the only avenue for respi-
ration remaining after occlusion of the nose, and that thus an

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[1] Galvanokaustik, 1871, S. 246 u. 312.

obstacle was placed in the way of respiration which disappeared on waking, just as Kussmaul supposes it to be in the case of nurslings. Quite recently, Haenisch[1] has also reported two cases of nocturnal asthma which occurred in connection with nasal polypi. One case, belonging to Voltolini's practice, and occurring in the person of a young lady twenty-three years of age, who did not suffer from emphysema, is highly characteristic, in this connection, because the nasal polypi, which complicated an ozæna of years' standing, recurred ; so that the occurrence of asthma on the return of the polypi, and its disappearance on their removal, was observed several times. The attacks described by Haenisch differ from those of my patients in this, that in the young lady just mentioned the acme of the paroxysm occurred some time, even though but a very short time, after waking. Haenisch observed at the same time increased volume of the lungs ; hyper-sonorous resonance ; the lower boundary of the lung, in front and on the right side, on a line with the margin of the sternum, remaining immovable at the upper margin of the seventh rib ; cardiac dulness somewhat diminished ; and the asthma, especially expiratory. After lasting for from three-quarters of an hour to an hour and a half, the attacks ended with the expectoration of tough, mucous sputa. Voltolini believes that these manifestations can only be explained on two suppositions : " Polypi either produce asthma by means of reflex action, or, by hindering breathing, they bring about an alteration in the chemistry of respiration and the texture of the lung tissue." The effect of long-continued nasal stenosis on respiration has been fully set forth in the preceding pages, and we decline to pass any judgment on the view—which certainly needs further proof, but the possibility of which, in view of the frequent simultaneous occurrence of stenosis and emphysema, cannot be denied,— that such serious changes in the lung-tissue as accompany emphysema may be produced in this way. We should have difficulty in accounting for *the sudden occurrence of asthma*, especially at night, on the ground of mechanical hindrances to respiration, even if the closure of the cavity of the mouth should

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[1] Berl. klin. Wochenschr., 1874, S. 503.

be confirmed by observation. I have never yet met with such a case myself, but it appears from Haenisch's description that over-distention of the lung takes place ; that, therefore, the impediment affects the act of expiration more than that of inspiration. Accordingly, the hindrance to respiration, in stenosis of the nasal cavity, cannot be considered as similar to that which exists in stenosis of the larynx, for in the latter it is inspiration that is made especially difficult. Of course it is admitted on all hands that respiratory movements carried on with obstructed mouth and occluded nose must materially disturb the relations of the blood and the air in the lungs, and the only doubts that can exist must be with regard to the finer points in the process. Movements of the polypi themselves cannot be regarded as the cause, because in one case observed by me asthma was occasioned by a polypus attached to the inferior turbinated bone by a broad base, and in which changes of position were impossible on account of its form. As regards reflex action, however, we are in possession of some experimental evidence which may be used in explanation of this circumstance. According to the experiments of F. Kratschmer,[1] an irritant, acting upon the mucous membrane of the nose, produces a narrowing of the nostrils and an arrest of breathing in the act of expiration, as well as an arrest of the heart's action, which is followed by a series of retarded pulsations. The reflex action originates, not in the olfactory but in the trigeminus nerve. Haenisch thinks we are justified in the belief that the irritation caused by a polypus is more likely to result in reflex action the more the interchange of gases in the lungs is interfered with. Further observations, which we desire to call forth by these remarks, must lead to more accurate conclusions with regard to the connection between occlusion of the nose and asthma.

Another result of closure of the nose affects the organ itself, inasmuch as one of its functions, *the sense of smell, is in the highest degree interfered with.* As the olfactory nerve is only distributed to the upper portion of the nasal cavity, the ordi-

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[1] Sitzungsb. d. kaiserl. Akad. d. Wissensch. Math.-naturw. Kl., II. Abth., 1870, B. LXII., S. 243.

nary respiratory current of air, as was shown above, does not penetrate in full force into the true olfactory region.[1] Therefore, even in a normal condition, if we want to perceive a smell accurately we take deep inspirations, or else do what is called snuffing. In snuffing we draw the air into the upper part of the nose by several short inspirations, followed by a powerful expiration. For it is an inevitable prerequisite to smelling that the matter to be smelled must come in contact with the terminal expansion of the olfactory nerve, and therefore, when the nose is closed, the sense of smell is dulled just in proportion to the diminished respiratory ventilation of the olfactory region, and the consequent lessened amount of odoriferous matter that reaches it.

But it is not only this principal function of the nose that is disturbed by stenosis or occlusion, the nose itself is also otherwise injured. The *removal of secretions*, etc. from its cavity is seldom left entirely to the force of gravitation, but is usually accomplished voluntarily by blowing the nose, or involuntarily by sneezing. The removal of secretions is rendered difficult, both in front of and behind the seat of obstruction, in proportion as the expiratory current of air is prevented from acting as a motive power, through narrowing of the canal. As it will appear from what follows that an accumulation of secretions may produce nasal stenosis, we thus have a "vicious circle" established, which is in the highest degree worthy of our attention and of therapeutic interference.

These are the results, as regards breathing and the nose itself, brought about by disturbed nasal respiration. But this does not exhaust the symptoms of nasal stenosis. Aside from the fact that closure of the nose obliges the individual always to breathe with his mouth open, thus imparting to his countenance a *vacant, silly expression*, which to a careful observer indicates the nature of his difficulty from afar, nasal stenosis also produces disturbances of speech and of hearing. In ordinary parlance we refer to people who speak *with their noses stopped up*, as "speaking through their noses," whereas this expression should be reserved for quite the opposite condition, in which, by

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[1] Compare *Bidder*, Wagner's Handwört. d. Physiol., II., S. 920.

closure of the isthmus of the pharynx, the air, in speaking, is prevented from entering the mouth, or, for other reasons, is made to escape through the nose; the same position of things existing as is normal in the pronunciation of the nasal *ng* sound. When the nose is stopped up, the tone, as it were, stagnates— to use the expression of Merkel [1]—in the side cavities into which it has digressed for the sake of complete resonance; it is obliged to return by the same way through which it entered, in order, finally, to find a way of escape through the mouth. (Obstructed nasal tone, Rhinophonia narium perperam clausarum.) The tone then becomes hollow and discordant.

As regards the effect of nasal stenosis on *hearing*, Lucae [2] was the first to observe that in every act of swallowing, under these circumstances, Toynbee's experiment was repeated, producing changes in the atmospheric pressure both in the fauces and the ear, accompanied by abnormal tension of the membrana tympani. If this tension is not regularly equalized, difficulty of hearing gradually supervenes.

We believe that in the preceding pages we have noticed all the symptoms of nasal stenosis, and cannot subscribe to the declarations of Uhlenbrock, [3] who assigns disturbed nasal respiration as a cause of dacryocystitis and lupus.

The *diagnosis* of closure or narrowing of the main cavity of the nose is easy. We have already indicated the aids thereto under the head of General Diagnosis (p. 70), and will merely add the following: When the nose is occluded, the flame of a candle held before the nostril affected will not be disturbed, or will be disturbed less than in a normal condition by the expiratory current of air. Wintrich has also noticed that the tympanitic sound produced by percussion of the larynx becomes perceptibly deeper, and at the same time weaker, as soon as (the mouth being closed) the nose is held shut. The difference of sound that ensues on closure of one nostril is less marked. If, then, no difference in the percussion sound of the larynx can be produced by holding one or both nostrils shut, it follows that there is

[1] Stimm- u. Sprachorgan, S. 652.

[2] Verhandlg. d. Berl. Med. Ges., 1867–68, S. 133, und Archiv d. Ohrkr., IV., S. 188.

[3] Deutsche Klinik, 1868, S. 401, u. 1869, S. 193 u. f.

nasal stenosis. As a general thing, however, the latter is so easily
recognized that such procedures are more valuable for demon-
stration than for diagnosis.

Mode of Occurrence and Causes.

Narrowing or closure of the nose may be *unilateral* or *bilat-
eral*, and may occur at any portion of the nasal cavity, in front,
in the middle, or in the vicinity of the posterior nares. As
before remarked, we shall have occasion in the following pages
to describe various causes for this condition. All circumstances
that close the naso-pharyngeal space likewise cause similar
manifestations. Aside from the beginning of respiratory para-
lysis, already alluded to (p. 106), we will here only consider
more closely *congenital errors of development*.

The first that may be mentioned is *closure of the nostrils by
a membranous growth*, though a far more frequent one is *bend-
ing of the septum* toward one side, generally the left. With
regard to this, Semeleder [1] states that in forty-nine skulls he
found the septum straight ten times ; bent toward the left,
twenty ; toward the right, fifteen ; and four times bent in the
shape of an S. Bending of the septum implies a diminution in
the calibre of the nasal cavity on its convex side, so that often
there is but a very minute space remaining, and even slight
swelling of the mucous membrane may be enough to induce com-
plete closure. But in these cases it rarely happens that the
other side of the nasal cavity is uniformly widened. Fre-
quently, and that not only in cases in which a very apparent
S-shaped bending of the septum is present, a point is also found
on the concave side of the septum at which the turbinated bones
approach nearer than is normal to the septum, so that there is
not complete compensation for the narrowing of the other side.
In this way there is almost always a unilateral, and sometimes a
bilateral, nasal stenosis brought about by bending of the sep-
tum. It may here be remarked that not only congenital, but
also accidental dislocations of the septum, as by fracture, etc.,
may produce the same results.

Rhinoskopie, S. 64.

We may have a *congenital bony closure of the posterior nares*, though this is apparently very rare.   Emmert[1] operated successfully on such a case in a boy seven years old, who had never from his birth been able to breathe through his nose, who was, therefore, as a nursling, reared with great difficulty, and who had, furthermore, often had suffocative attacks during sleep.   No air ever came out at his nostrils, but mucus did, as well as a stream of tears when he cried.   In some respects, therefore, this boy may serve as a model of the manifestations produced by atresia of the nose.   The closure was occasioned by a bony wall, covered on both sides with mucous membrane.   Luschka[2] had the opportunity of amplifying this observation on the cadaver of a girl who had died soon after birth.

In this case the bony framework was formed by the palatal bones on both sides.   The posterior normally free and concave border of the horizontal plate was continued in a somewhat oblique direction, upward and backward, to the lower surface of the body of the sphenoid bone, being attached to the latter by a serrated edge.   Laterally, the bony plate reached the inner side of the lamina interna of the pterygoid process.   In the median line, the lamella joined its fellow of the other side at the point where the posterior nasal spine usually rises, while the two, in their further progress upwards, were separated by a very narrow slit, into which the lower extremity of the rudimentary vomer had penetrated.

I myself once saw a case of closure of the posterior nares, on the right side, in a young man, the conditions of which corresponded most accurately with those of bilateral atresia.

Dr. J. Wolff, who sent the patient to me for a rhinoscopic examination, had established his diagnosis by means of palpation of the pharynx and probing the nasal canal, and had succeeded, by means of an operation, in perforating the bony partition wall.   I was enabled by inspection to satisfy myself of the existence of a smooth and solid wall, covered on both sides with mucous membrane, and closing the right fossa in precisely the manner described by Luschka.   The crista of the septum showed itself, even on the closed side, as a narrow strip.   No other abnormality could be seen.   The artificial opening eventually became reduced to the size of a pea, but it was still sufficient to relieve the patient from all annoyance.   This had been caused exclusively by the fact that the patient had been unable to blow his right nostril, and that he had been excessively troubled by the accumulations sometimes escaping spontaneously in front.

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[1] Lehrb. d. Chir.   Stuttgart, 1853, B. II., S. 553.
[2] Der Schlundkopf.   Tübingen, 1868, S. 27.

Treatment.

As regards the *treatment of nasal stenosis*, we again insist on the importance of the permeability of the nose for the general well-being of the individual, and on the need of removing stenosis, where it exists. I can confirm the remark of Tröltsch,[1] that parents report their children as having improved in every way, physically and mentally, after the energetic treatment of chronic "cold in the head"—which was leading to habitual impermeability of the nose. The treatment falls principally within the domain of surgery. The methods of treatment belonging to internal medicine will be spoken of in connection with those diseases which demand them. We will here confine ourselves to the following remarks : Traube used mechanical means against the inspiratory narrowing of the nostrils at the beginning of respiratory paralysis. He introduced two hair-pins into the nostrils, with the round end turned inward, and fastened the points to the forehead with sticking plaster, thus keeping the alæ of the nose removed from the septum.

Hoppe[2] prefers *the use of hollow bougies as dilators*, in narrowing of a moderate degree ; a method which especially commends itself in the *coryza of the new-born*, in whom breathing during the act of suckling is rendered possible by the rigid tubes (pieces of gum elastic catheter) which are introduced into the nostrils. This author also advises *forcible distention* by means of a pair of thin, long-armed forceps, by the opening of which the abnormally approximated bones are to be driven apart from one another.

Rupprecht[3] describes a pair of biting forceps, similar to the instrument with which railroad conductors punch tickets, and which is to serve the purpose of cutting out the bent portion of the septum. According to the inventor of the instrument, not only is a communication established between the two sides of the nasal cavity, but the permeability of the closed side is also restored.

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[1] Lehrbuch d. Ohrenheilkunde. Leipzig, F. C. W. Vogel, 1873, S. 306.
[2] Neue Ztg. f. Med. u. Med.-Ref., 4, 1850.
[3] Wien. med. Wochenschrift, 1868, S. 1157.

It needs hardly to be said that in nurslings who refuse to take the breast, on account of closure of the nose, *artificial feeding* with a spoon, and, if necessary, with an œsophageal tube, and the injection of milk, etc., into the stomach, must be undertaken. Kussmaul describes this process, which Thiersch successfully employed in the case of his own child. It should be remembered, however, that in many cases the disturbances were aggravated as soon as the children were laid in a horizontal position. It is therefore better to hold them, or lay them, *with their heads high*.

"COLD IN THE HEAD," RHINITIS, CORYZA.

History.

The nose is the classical seat of catarrh. The name catarrh, from καταῤῥέω, to flow down, which has remained attached to the whole family of diseases which we designate as such, originated in the idea which the ancients had with regard to that secretion, especially, which escapes from the nose. Hippocrates, as well as Galen, believed that the secretion of the nose, and to some degree also that of the larynx and pharynx, flowed down out of the brain. These matters flowing away were considered a sort of cerebral purge, and it was believed that the pituitary gland as well as the sphenoid bone indicated the path by which these excretions of the brain reached the nose. Schneider, Professor in Wittenberg, whose name, under the appellation of Schneiderian membrane, the mucous coat of the nose still perpetuates, in his comprehensive treatise, "De Catarrhis," published in Wittenberg in 1660, showed the falsehood of this supposition.

He based his declarations, above all, on the anatomical demonstration that no canals existed through which such a distillation could take place. His work is divided into three books, the first of which treats, "De speciebus Catarrhorum, et de Osse cuneiformi per quod Catarrhi decurre finguntur" (Of the Varieties of Catarrh, and of the Sphenoid Bone through which Catarrhs are supposed to flow down). In the second he shows that Galen's theory of catarrh was false, and in the third he announces the new theory. Therein he comes to the conclusion that the secretion is separated from the blood by the mucous membrane itself. The

nasal mucous membrane sweats constantly—Schneider calls the exudation chiefly "sudare"—in almost all men, to a slight degree, even under normal conditions. " Si vero natura ex massa sanguinea humores in has membranas pellit, plus humoris se de illis effundit, ut tandem catarrhus hominem exercat. Atque multus vel paucus humor etiam alieni coloris, saporis, et denique habitus esse potest. Est vel visu sanguineus, vel nigricans vel croceus, est acrior et salem recipit, vel sapore dulcior, interdum fluxior, est vel constantior, nunc tenuior aut spissior, et, ut cum illo loquar, corpulenior."—Lib. III., cap. VII., p. 578. (If, in truth, nature expels humors from the mass of the blood into those membranes, it will the more relieve itself from such humors where the man is troubled with catarrh. And, indeed, the humor may be abundant or scanty; it may even be varied in color, taste, and quality. For to the sight it may be blood-red, or blackish, or yellow; it may be acid and salty, or of a sweetish taste; it is sometimes transitory, at others constant; now thin, then again thick, and even, if I may call it so, fleshy.) He believed the accumulation of catarrhal matter in the blood to result from luxurious living— " Qui abundant divitiis, laborant plerumque abundantia pituitæ."—Lib. III., p. 600. (Those who abound in riches generally suffer from an abundance of phlegm.) For this reason, he thinks, man is more frequently attacked with catarrh than the lower animals, and dwellers in the city than country people. The religious aspect of Schneider's work, which is evident in various places, shows itself plainly in his therapeutics of catarrh, as contained in the following sentence: " Ut ex luxu ac otio nascuntur Catarrhi, ita horum medicina est in sobrietate, in continentia, in exercitationibus corporis, in mentis tranquillitate." (Inasmuch as catarrhs are born of luxury and indolence, therefore their appropriate medicine consists in sobriety, in continence, in bodily exercise, and in tranquillity of mind.)

The old view of the cerebral origin in the brain, which Schneider, at great labor, annihilated forever in his learned work, and which a physician now only hears of when he studies the history of medicine, has still perpetuated itself to the present day in various popular expressions and beliefs. Among these may be mentioned the French name for coryza, " Rhume de cerveau;" the supposed efficacy of hellebore and other sternutatives in brightening the understanding; and the beautiful custom of wishing a hearty "good health!" to him who, by a vigorous sneeze, has embraced the shortest way of clearing up his brain.

At the present day we know that mucus does not exist already formed in the blood, and we regard catarrh of the nose, like that of any other mucous membrane, as an actual inflammation of the same, whose peculiarities are imparted to it chiefly

by the qualities characterizing this portion of the mucous membrane, and which runs its course accompanied by a free exudation of a serous or muco-purulent character.

Etiology.

In considering the etiology of coryza, we shall be obliged at this time to avoid entering into the etiology of catarrh in general—and especially its relations to the act of taking cold, its dependence on atmospheric influences and geographical position, as well as peculiarities of race—inasmuch as, according to the plan of this work, these questions are to be discussed elsewhere. We shall therefore confine ourselves here to those considerations that particularly concern the nose.

Catarrh of the nose is met with *sporadically* and *in the form of an epidemic,* and one of the first questions to be considered is whether or not it is *contagious.* Among the laity it is regarded as an incontrovertible fact that a cold in the head may be communicated from one person to another, both by direct contact with the secretion (as in using the same handkerchief, etc.), as well as by mere approximation of the diseased organ to a healthy one—in the act of kissing, for instance. And indeed it cannot be denied that there is a great deal of evidence in favor of the theory of contagion. In this connection the almost uniform propagation of the evil from one nostril to the other might be mentioned, as a unilateral acute rhinitis is quite a rarity. We likewise often have occasion to observe how one member of a family after another is attacked—and not all simultaneously—without our being able to find any etiological reason (such as changes of weather, exposure to cold, etc.) for the production of the later cases. I have also repeatedly noticed that a bridegroom, who had never had a cold in his head, was seized with one, for the first time, during fine weather and without any other perceptible cause than that his bride, who was subject thereto, had coryza. Similar observations might easily be multiplied which cannot, without violence, be reconciled to any other theory than that of the contagiousness of coryza.

The fact of the *epidemic* occurrence of acute catarrh is also

difficult to explain in any other way.   Those who deny its conta-
giousness attribute the epidemic spread of catarrh to influences
of a universal character, such as the state of the weather, etc.,
and quote, in this connection, the observations of Anglada,[1]
according to whom, after a severe thunder-storm, coryza sud-
denly broke out, as an epidemic, among the French troops
returning from Salamanca (1812), the other mucous membranes
remaining free.

Such observations, which may often be made on a small scale
by those taking part in some excursion into the country, after
all only prove that circumstances sometimes occur capable of
producing rhinitis simultaneously in a large number of people.
Of themselves they neither constitute an argument against the
contagiousness of coryza nor do they furnish a legitimate expla-
nation for epidemics of any considerable duration.

On the other hand, we may not ignore the fact that up to
the present time no one has succeeded in *demonstrating the
contagiousness of coryza by experiment;* on the contrary, all
attempts in this direction have resulted *negatively.*   Thus Fried-
reich[2] inoculated his own nasal mucous membrane with the
secretion of persons in various stages of coryza, with a uniformly
negative result.   Hiller,[3] too, who succeeded in producing a
purulent secretion upon the genitals, and in transferring this
from the genitals of one animal to those of another, failed in his
attempts on the nasal mucous membrane.   Hiller explains his
failure on the ground that the matter to be inoculated was
washed away by the secretions of the nose, and that thus an
essential element of success, the retention of the vehicle, was
lost.   He admits that in the case of the genital mucous mem-
brane he accomplished this end by mechanically producing an
irritative hyperæmia.   It may therefore be raised as an objec-
tion to all previous experiments, that the conditions under
which this contagion develops its efficacy are unknown to us.

On the other hand, the nose shows itself unequivocally sus-
ceptible to the contagion of *gonorrhœal matter* ; at least it is

[1] Du Coryza simple.   Paris, 1837.

[2] L. c., p. 398.

[3] Untersuch. über die Contagiosität purulenter Secrete.   Berl. Diss., 1871.

certain that this secretion is capable of infecting the nose. For the nasal mucous membrane, just like the conjunctiva of the eye, may be attacked by the gonorrhœal poison. Indeed this infection is not accomplished indirectly alone, as by the fingers, cloths, instruments, etc., but, according to Siegmund,[1] it may be direct, as in one case which he narrates of an impotent old roué who introduced his nose into the vulva of a whore who had the clap, and by means of this unnatural and disgusting use of his nose caught a purulent inflammation of the nasal mucous membrane, which afterwards spread to the conjunctiva. Siegmund believes that the pointed condylomata often found at the entrance of the nose are probably due to such nasal gonorrhœas that have been overlooked.

Now, as the specific nature of the gonorrhœal virus is, at present, almost universally denied, it does not appear on what ground one would be justified in assuming, at the outset, that infectious secretions are not contagious to the nasal mucous membrane, as it is evident, from the above and many other cases, that gonorrhœa may be communicated to this membrane just as well as to the conjunctiva, or any other mucous surface. It is also more than likely that *the coryza of new-born children originates in the same way as ophthalmia neonatorum*, viz., through infection of the nasal mucous membrane by the vaginal secretions of the mother during birth. The connection between these two has hitherto not been sufficiently insisted on ; in fact about the only allusion to it that I find in literature is a case that occurred in the German Hospital in London, and was reported by Herm. Weber.[2] A well-developed boy, whom they were not able to wash until some three hours after his birth, and whose mother, during the last weeks of pregnancy, had shown an abundant vaginal leucorrhœa, soon developed a yellow discharge from his nose, and inflammation of the left eye, with secretion of pus. In the same way, on closer examination, it will be found that by far the larger proportion of cases of coryza neonatorum, arising within the same period as the ophthalmia of

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[1] Wien. med. Wochenschrift, 1852, S. 572.

[2] Medico-Chirurg. Transact., XLIII., p. 177.

that age, and sometimes associated with it, is to be attributed, not to taking cold immediately after birth, nor to a peculiar sus ceptibility of the mucous membrane, but to an infection in the vagina of the mother.   At least in almost all cases of coryza neonatorum that I have investigated, I have been able to show the existence of leucorrhœa in the mother.

It appears, then, beyond a doubt, that the nose does not differ from other mucous membranes in its capacity for being infected by secretions.   Nor is there any ground for considering the secretions of the Schneiderian membrane as less infectious than those formed elsewhere.   The question of the contagiousness of coryza, then, in spite of the negative result of experiments, must be considered as one and the same with the question of the contagiousness of catarrhal or purulent secretions in general, and in the light of clinical observations must, for the present, be answered in the affirmative, especially as regards purulent secretions.

As regards the etiology of sporadic rhinitis, aside from all considerations of infection, it may be remarked that some men show a decided *predisposition* thereto, an attack being brought on in them by very slight causes which would not affect the majority of people.

The most frequent causes of coryza are atmospheric influences and *taking cold*, especially by means of sudden cooling of the surface of the body after being heated.   Many people attribute a cold in the head to having got their feet wet, and it is not to be denied that the feet are a portion of the body which we generally clothe most warmly, and which are most exposed to those vicissitudes that produce what we call "a cold."   As was previously stated, we must here abstain from any discussion of the relation between " taking cold " and catarrh.

Coryza may also be produced by *irritants affecting the nose directly*.   There are persons who cannot step into a room con taining powdered ipecac without getting a cold in the head. Hühnerwolff reports the case of a man who could never inhale the perfume of a rose without being thus seized.   Sensitiveness to the impression of iodine and its haloids is more universal, while there is a not inconsiderable number of people in whom

the internal use of these remedies will produce the disease. We cite the use of iodine under the head of direct irritants to the nose, because probably the iodine which is taken up by the vessels of the mucous membrane, and which can easily be demonstrated in the secretions, produces the coryza. In this connection we may state that Stadion [1] was seized with a severe coryza during good weather, on the second day before concluding his experiments on himself with regard to the action of digitaline. He undertakes to prove that it was due to the action of the digitaline.

The *inhalation of acrid gases* may produce coryza ; so also extreme cold, dust, or other impurities of the atmosphere. Direct wounding of the nose and the entrance of foreign bodies into it seldom lead to extensive catarrh, even when they produce a circumscribed inflammation. On the other hand, the entrance of the pollen of plants appears to produce the disease known as "summer catarrh" or "hay fever" (compare this Cyclopædia, Vol. II., p. 544).

Coryza constitutes a *symptom of the initial stage of various acute infectious diseases*, especially of measles (this Cyclopædia, Vol. II., p. 71), and of exanthematous typhus (*ibid.*, Vol. I., p. 314, as well as of influenza (*ibid.*, Vol. II., p. 529). Other infectious diseases, especially typhoid fever and scarlatina, are at first almost a protection against coryza (*ibid.*, Vol. I., p. 129, and Vol. II., p. 107). The subject of glanders has been treated of in the third volume.

Although the reverse of this generally holds true, yet it is not altogether uncommon for rhinitis to result from inflammation of the neighboring organs ; thus it may follow pharyngitis, laryngitis, conjunctivitis, or facial erysipelas.

Nurslings and children during the first years of life are the most subject to this disease ; next to them, in point of liability, are persons of middle age, youth and old age being comparatively exempt.

Symptoms.

The *forerunners* of coryza are a feeling of lassitude in all

[1] Prager Vierteljahrschrift, XIX. Bd., S. 129.

one's members, slight chiliness, and a sensation of weight and
pressure in the head, especially about the forehead. Patients
feel as if they had a board bound to their forehead. It was from
this symptom that the affection received its name of Gravedo or
Coryza. At the same time there is prickling and dryness of the
nose, and a frequent disposition to sneeze. Redness and swelling
of the nasal mucous membrane soon supervene, and an increase
of the secretion of the organ begins. At first the flow is *watery*,
then of a salty, *mucous* quality, according to Donders and
Schönbein also containing ammonia ; and, finally, it is, as a rule,
more or less purulent in character. It is either discharged from
the nostrils spontaneously, or removed by sneezing and blowing
the nose. The amount of the secretion poured out during a
given time varies ; often, however, especially at the height of the
affection, it is very copious, amounting to a continuous dripping.
There is usually a partial loss of the sensation of smell, more
rarely also of that of taste, with fever which is probably always
slight, though no exact measurements of it are on record.

The symptoms depicted above are those of the light form of
coryza, one of the most common forms of disease. In an acute
rhinitis, however, all of them may be met with in an aggravated
form, according to the severity of the disease or the peculiarities
of the individual ; for there are men whom this ordinarily insig-
nificant affection attacks like a severe disease. The following
symptoms may be studied more closely :—

The degree of *swelling of the mucous membrane*, like every-
thing else about the disease, is very variable. In most cases,
however, it is enough to produce stenosis, if not actual occlu-
sion of the nose ; conditions, the signs of which have been
described above. The swelling often arises very suddenly, and
subsides as suddenly, a circumstance which led Weber [1] to
explain the occurrence of nervous asthma in the same way as
this closure of the nose, viz., by hyperæmic swelling of the
mucous membrane. But the anatomical relations of the nasal
mucous membrane are quite peculiar, and are different from
those of the bronchi, being so arranged as to admit of a sudden

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[1] Tgbltt. der 43. Naturforscher-Vers., 1873., S. 159.

rise and subsidence of swelling. Through the publications of
Kohlrausch,[1] the existence of cavernous or erectile bodies
between the periosteum and mucous membrane on the turbinated
bones, especially on their hinder portions, has become better
known ; and it is probable that these venous cavities, supported
by the numerous anastomoses that here exist among the arteries,
play an important part in the swelling of the nasal mucous
membrane, through the inflammatory changes produced in the
walls of the vessels. Hence, entirely irrespective of the correct-
ness of Weber's theory in itself, the nose cannot, in this respect,
be compared to other portions of the respiratory apparatus. The
fact, that the swelling in such cases depends on changes in the
vascular system is evident on ocular inspection, which shows us
the mucous membrane dark-red and bursting with blood. Kohl-
rausch calls attention to the fact that, as a result of the venous
network described by him, settling of the blood, by the force of
gravitation, explains a circumstance which may often be noticed,
viz., that on lying down the nostril that is undermost is the
most likely to be stopped up.

The *secretion*, even aside from its admixture with tears, is at
first serous. After a time, mucus in considerable quantities is
added to it, giving to the fluid a thickish, tenacious character.
The nose is one of those organs of the body in which the question
of the origin of mucus is capable of several different answers.
The olfactory region contains tubular glands (Bowman's), while
the nasal mucous membrane proper contains better developed
glands, resembling the lobulated variety. But even the latter,
according to A. Haidenhain,[2] furnish a secretion which does not
throw down a precipitate on the addition of acetic acid, and
the chemical reactions as well as microscopical appearances of
which justify us in classing it among the serous secretions, and
consequently in separating these glands from the muciparous
variety. It appears, then, that here also the mucous secretion is
a product of the entire mucous membrane, which in this locality,
in man, is ciliated throughout ; and that, if Haidenhain's obser-

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[1] Müller's Archiv, 1853., S. 149.

[2] Ueber die acinösen Drüsen der Schleimhaüte, u. s. w. Bresl. Dissert., 1870.

vations are confirmed, the glands take no part in its production. Mucus appears either as the product of the separating power of the epithelium, or it is formed by the mucous degeneration and melting down of these cells, and is carried to the surface by the stream of fluid escaping from the vessels.   But the coryzal secretion always contains mucus as soon as the short, initial, serous stage is passed, as may be plainly proved by the addition of acetic acid, and by its behavior generally.

Microscopic examination of the mucous secretion always shows white blood- (pus-) corpuscles, besides the so-called mucus corpuscles, and sometimes red blood-corpuscles and epithelium. A large number of those little structures, recently so much spoken of and called micrococci, may generally be seen, also covering the cells.   In accordance with his general theory of inflammation, Hueter [1] regards these micrococci as the true sources of irritation in coryza.   In addition to the above, the secretion sometimes contains accidental formed ingredients, which floated on the inspired air, and were thus mingled with the fluids in the nose.   The number of pus-corpuscles is very variable.   They usually increase with the duration of the secretion, until, owing to the greater power which these cells possess of refracting light, they give to the entire mass that turbid, opaque appearance characteristic of what we call a muco-purulent or purulent secretion. On close observation, a stage, even though quite short, will appear towards the end of a coryza, during which the fluid effused will at least be entitled to the name of muco-purulent.

The secretions accumulated in the nose, when they are moved by the air passing through them, produce a peculiar moist or snuffling sound which can generally be heard at a distance. The ear so surely indicates the seat of this sound that it can hardly be mistaken for anything else.

Course.

The same thing that takes place everywhere else may be observed here, viz., that the appearance of a secretion on the surface is associated with relief to the inflamed parts.   Hence

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[1] Allgem. Chirurgie.   Leipzig, 1873, p. 257.

no doubt originated, first, the idea that the secretion was a "purgamentum cerebri;" and second, the disposition of the laity to deduce a general principle from the observation that pain in the forehead and pressure in the nose are relieved when the secretion begins, and to think that wherever these feelings exist there ought to be mucus to be loosened and brought out.

Coryza is an affection which, in the vast majority of cases, terminates in *recovery*. A *fatal* termination is extremely rare, and only takes place in nurslings, owing to the disturbances of respiration and nutrition incident to closure of the nose, as was described above; or in very old people who have about reached the limits set to all organic life and would have died soon under any circumstances. *Acute rhinitis* does not very often end in the *chronic affection;* when it does, it is either owing to neglect, or dependent on some dyscrasia, or happens in persons who frequently suffer from coryza.

The *duration* of the attack is usually from two to seven days, according to individual peculiarities and the severity of the causes producing it; at the end of this time, if no complications exist, acute rhinitis generally ends in recovery.

Complications.

The first *complication* to be noticed is the invasion of neighboring organs. The most common *propagation* is to the epidermis,—the mucous membrane, even before leaving the interior of the nose, passing into the epidermis without any well-marked line of demarkation. The external skin of the nose swells and grows red, and the epidermis in the vicinity of the nostrils is often excoriated, both by the irritation of secretions flowing over it and the violence it suffers in the frequent act of blowing the nose. Furthermore, it is not very uncommon for erysipelas of the face to result from rhinitis; indeed, this is the most frequent exciting cause of the disease in those who habitually suffer from erysipelas.[1] Extension of the inflammation backward leads to pharyngitis, and not rarely to catarrh of the Eustachian tubes, producing ringing in the ears, difficulty of hearing, etc. Pha-

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[1] Compare Vol. II. of this Cyclopædia, pages 429, 458, 473.

ryngeal catarrh may extend further down the respiratory tract, to the larynx, the trachea and bronchi. But there is a laryngitis, tracheitis, etc., which may be associated with rhinitis of longer standing, without any evidence, subjective or objective, of implication of the pharynx, either beforehand or at the time. In these cases, then, the anatomical connection is lost, and every one is left to fill the gap according to his own judgment, on the theory of an after-effect of the original poison, or on that of the aspiration of the secretion. The inflammation may also spread through the lachrymal duct to the lachrymal sac and the conjunctiva, and even affect all the cavities contiguous to the nose. If the catarrh involves the frontal sinus, the cavities of the ethmoid or sphenoid bone, it is said that there is a marked increase of headache; if the frontal sinus, the pain is in the forehead. If the antrum of Highmore is attacked there will be severe pain in the cheek. But it is to be remembered, in this connection, that neuralgic pains, radiating in the course of the trigeminus and neighboring nerves, may also exist when the antrum is not involved. The fifth pair of nerves has a large terminal distribution in the nasal mucous membrane, and its tendency to radiating sensations is otherwise sufficiently well known. Such neuralgias of the fifth pair, dependent on nasal catarrh, have been described by Duchek,[1] Oppenheimer,[2] Rollet[3] and others.

Swelling of the lymphatic glands is another complication of coryza, occurring especially in scrofulous individuals.

Little is known with regard to the lymphatic vessels of the nasal mucous membrane. Heiberg-Hjalmar,[4] in Christiania, describes an open system of canals therein, fron which, however, the lymphatic vessels could not be injected. Edmund Simon[5] describes the course of the lymphatic vessels as being such that the main trunks of the same, which open into the lymphatic glands, run in a sort of furrow between the forward end of the Eustachian tube and the rear end of the turbinated bones. Here they form a small network, from which two or three trunks of about one millimetre in diameter arise; these run obliquely backward and outward

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[1] L. c., p. 441.

[2] Verhandl. des naturh. med. Vereins zu Heidelb., VI., S. 198.

[3] Wiener Presse, 1873, S. 1145.

[4] Jahresbericht, 1872, I., S. 45.

[5] Schmidt's Jhrb., 107. B., S. 161.

between the levator and the tensor palati mollis muscles, and after they have passed these muscles, one branch passes along the external wall of the pharynx, between the internal carotid and the stylopharyngeus muscle, and, after various windings, terminates in a gland in front of the vertebræ. *Hence retro-pharyngeal abscess may arise in consequence of diseases of the nose.* The second trunk (and also the third, if there is one) passes obliquely downwards, outwards, and backwards, separated from the pterygoideus muscle by masses of fat; perforates the digastric, passes to the outside of the lingual nerve, and to the inside of the stylo-hyoid muscle, of the posterior belly of the digastric, and of the internal carotid; divides into two branches, and terminates in two lymphatic glands lying under the sterno-mastoid muscle.

At all events the lymphatic passages of the nose eventually lead into those of the neck, and in coryza swollen glands will be found under or behind the sterno-cleido-mastoid, if these organs are at all implicated. It is not very uncommon for swelling of the glands to outlast the catarrh which caused it, and then it may remain as an independent affection, subject to further changes.

Pathological Anatomy.

As regards the pathological anatomy of rhinitis we have no records of any special observations made on the dead body, and it is not yet determined which region of the nose is especially affected by acute inflammation, whether the olfactory or the respiratory. According to clinical observations the latter should be the preferred seat of this disease.

Treatment.

The attempt at an abortive treatment of this affection, by means of the Hager-Brand remedy, has already been discussed under the head of General Therapeutics, on page 96, and the treatment of nasal stenosis in nurslings has also been given above. We may further add that the treatment of this disease, which usually soon terminates in recovery without any interference, is attempted in two different ways. While one set of people recommend fresh air, open windows, and cool baths; another set insist on diaphoretic treatment with appropriate medication, Roman or Russian baths, and a rigid diet. I cannot recommend either of these methods, as they neither cut short

the attack nor modify its severity.   In ordinary cases of cold in
the head, an essentially expectant plan of treatment, with some
care as to the person's diet and surroundings, seems most desir-
able.   Where circumstances permit, it is better that patients
should not go out except in good weather, but remain in-doors,
the rooms being, of course, well ventilated.   It is not neces-
sary to take to one's bed unless fever is high, or the attack
uncommonly severe, and even then care must be taken not to
pile on too many bedclothes.   These precautions are especially
to be recommended in the case of children, or of those adults in
whom experience has shown that coryza is likely to be followed
by bronchial catarrh of greater or less severity.   Whoever has
had a cold in the head knows that while it lasted his skin was
especially sensitive to cold, and that he was instinctively dis-
posed to protect himself against those changes of temperature
which, when he was well, would not have been noticed.   While
we cannot recommend vigorous diaphoretic treatment, in which
the laity have too great confidence, we would just as little advise
any one utterly to disregard a cold in the head, and look upon
it as not being a disease.

It is well, especially where there is considerable pain, or the
tendency to sneezing is excessive, to apply morphine locally,
either by snuffing up a teaspoonful of a solution of from three-
quarters to two and a quarter grains in a fluid ounce and a half
of water, or by using this as an injection ; or, in the form of a
powder, from a sixth to a quarter of a grain being snuffed up
dry.   Opium is also recommended instead of morphine.   Aside
from this we may order injections or inhalations of a five- or ten-
grain solution of common salt, or of carbonate of soda, with the
addition of glycerine, etc., all these being especially intended to
loosen and remove the mucus.   In case of excessive secretion, as
well as extreme swelling, or after abatement of the inflamma-
tory symptoms, the topical application of astringents may be
indicated (borax, tannin, alum, nitrate of silver.   See General
Therapeutics).

Although we believe that the foregoing means are sufficient for the treatment of
coryza, yet we must not fail to mention that the following methods have also been
recommended.   Amongst the means for abortive treatment are ice-cold foot-baths ;

the dry diet, that is to say the withdrawal of all drinks and moist articles of food for two days; stopping up the nostril invaded with a piece of sponge, or with a pledget of lint dipped in collodion; the snuffing up of the vapor of acetic acid for ten minutes, out of a bottle filled with the acid; the application of a five-grain solution of nitrate of silver. Furthermore, as treatment for the catarrh, the snuffing up of calomel; the application of mercurial ointment; poultices over the nose, etc. A favorite popular remedy in the coryza of children is anointing the nose externally with various oily matters, especially "ointment of sweet marjoram."

Prophylactic measures consist in avoiding the inducing causes, and in people who are often troubled with coryza, and unable to determine the cause, it is well to undertake a systematic hardening of the skin.

PURULENT NASAL CATARRH.—RHINITIS BLENOR-RHOICA.

By this name we designate a disease which represents an aggravation of ordinary catarrh, that is, a coryza gravis, and whose most prominent feature is the flow of a purulent secretion accompanying inflammatory manifestations. In view of its character it would be etymologically more correct to call it a pyorrhœa than a blennorrhœa. But I have not chosen to give up the former name of blennorrhœa, both because it is only used in one sense, and, therefore, no confusion can arise, and also because the same condition in other organs, especially of the neighboring structure, the conjunctiva, is designated by the same name.

Etiology.

Purulent nasal catarrh is a tolerably rare disease. It occurs, first, *in new-born children*, and this is the form in which I have principally seen it, being due, in my opinion, as above stated, to *infection of the nose with the blennorrhœal secretion of the maternal vagina.* Just as conjunctivitis neonatorum shows different grades of severity, so the same causes produce different degrees of inflammation in the nasal mucous membrane, and this is one reason why the connection of cause and effect, which

in the present case is very striking, was mentioned under the head of simple catarrh. The time of its appearance, during the first few days of life, its occurrence simultaneously with vaginal blennorrhœa in the mother, and the exclusion of other causes, make it probable from the outset that the etiology of nasal blennorrhœa of the new-born is the same as is now universally accepted for ophthalmia neonatorum. In the literature of the subject, this origin of nasal blennorrhœa is not made prominent, and yet many facts are adduced which support the assertion of the origin of this severer rhinitis from infection within the maternal vagina. I would especially cite the fact, in this connection, that in many cases in which this disease is described, particular mention is made of its having manifested itself either immediately, or, at all events, very soon after birth, through sneezing, or a bloody serous discharge from the nose. I allude to Weber's case above, and would here like to make a quotation from the essays of Hauner,[1] who is particularly emphatic in calling attention to this malignant nasal catarrh of nurslings. He says : ''The cause of this nasal catarrh must doubtless be sought in an individual predisposition to catarrhs in general, and in the fact of taking cold. Dyscrasias, especially syphilis, never cause this malady, and the coryza syphilitica, which is either a forerunner of the constitutional outbreak, or occurs coincidently with other similar affections in various organs, can *never* be mistaken for this cold in the head by a person of any knowledge. I have seen children of this kind *possessed of great irritation of the nasal mucous membrane from the moment of their birth*, so that they were greatly troubled with sneezing and an excessive secretion from the nose.'' He also explains the fact that Rilliet and Barthez do not mention this disease, on the ground that they could never have seen it, as the children that fell under their observation were all over fifteen months old. What was once true with regard to ophthalmia will hold good here, viz., that ''individual predisposition '' and '' taking cold '' will only play their rôle as long as infection with the secretions of the maternal vagina are not

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[1] Jahrb. der Kinderheilkunde, N. F., 1862, V., p. 74.

taken into account. Extension from the conjunctiva, which is quite possible, cannot be accepted as the only explanation of this disease, for I have seen cases of nasal blennorrhœa without any coincident conjunctivitis. It is a singular thing, though, that the nose, which is not provided with any protective apparatus, is not as frequently infected during its passage through the vagina as the conjunctiva. It may possibly be that movements of the lid favor the entrance of infectious material into the conjunctival sac. But if we take into consideration the failure of attempts to infect the nasal mucous membrane (see above), and other circumstances, such as the rarity of primary nasal diphtheria, it seems probable, not that there is a special predisposition of the conjunctiva, but that the Schneiderian membrane must in reality have some physiological provision (perhaps its ciliated epithelium) which protects it from the influence of this contagion. Later in life the same provision enables this organ to act as a sort of filter to the inspired air, with almost complete immunity against morbific influences excepting those which occasion that comparatively innocent affection—coryza.

Nasal blennorrhœa may be caused, secondly, by the action of *gonorrhœal matter*. Here, too, it may vary in intensity from that of an apparently simple catarrh to that of the most severe blennorrhœa and diphtheria.

Nasal blennorrhœa occurs, *thirdly*, during the course of *scarlet fever* (which see) and under the influence of *variola ; fourthly*, in *diphtheria* of the pharynx and of the conjunctiva ; *fifthly*, after *burns* and *cauterizations* of the mucous membrane ; *sixthly*, by *extension* from the conjunctiva or pharynx ; *seventhly*, from *unknown causes*, perhaps from the aggravation of simple catarrh. A *circumscribed* purulent inflammation may take place in the mucous membrane of the nasal cavity after wounds, cauterizations, and other therapeutic interference, as well as after operations within the same (compare below : Parasites of the Nasal Cavity).

Symptoms.

The symptoms of acute nasal blennorrhœa consist in an

aggravation of all the manifestations described above under
the head of coryza. The general appearances, in particular,
from the beginning, are those of a serious illness, and the swell-
ing of the mucous membrane is also much more considerable
than is usually encountered in an ordinary cold in the head.
But what especially distinguishes this disease is *the secretion.*
Whereas after the serous initial stage of ordinary coryza the
mucous secretion is the most prominent one of the three, both as
to quantity and duration, in blennorrhœa a purulent flow
appears very soon after the beginning of the disease. Sometimes
it is thin and glutinous, sometimes it resembles laudable pus in
appearance, and again it may be decidedly fetid, or discolored
from an admixture of blood, but it always has the characteristics
of a purulent secretion, and maintains this character uninter-
ruptedly throughout the duration of the disease, unless, indeed,
it becomes ichorous. As a rule, the discharge is rather solid in
consistency, and thus, owing to swelling of the mucous mem-
brane and the accumulation of the secretions rich in albumen,
considerable nasal stenosis accompanies blennorrhœa. Here
those manifestations which were described above as character-
izing nasal stenosis in nurslings will present themselves in an
extreme degree.

Nasal blennorrhœa is often complicated with ulcerations of
the mucous membrane, and may spread to the conjunctiva and
to the pharynx (ear). The external skin in the vicinity of the
nose, especially that of the upper lip, is almost invariably in-
volved and excoriated.

Course and Terminations.

Blennorrhœa of the nose is always a disease of considerable
duration. This is especially true of blennorrhœa neonatorum,
because, being regarded as a harmless cold in the head, it is not
subjected to medical treatment for some time, and usually lasts
seven, eight, or nine weeks, or even longer. The structure of the
nose offers particularly favorable opportunities for a purulent
inflammation to take root, while extensive regions thereof (the
neighboring cavities, etc.,) are almost entirely inaccessible to

local therapeutic treatment. Purulent rhinitis is a disease which may, and sometimes does, terminate in death. Not only because in many instances it arises during other severe diseases (diphtheria, scarlatina), but because it robs the individual attacked of quiet sleep, and in nurslings interferes materially with nutrition. Severe brain symptoms may also be associated with it, and infants especially are liable to be very dull and sleepy from the outset. Herman Weber (l. c.) reports severe evidences of cerebral disturbance (cramps, partial hemiplegia), in cases in which the secretion of the nose was suddenly diminished, and he gives special prominence to the fact of the disappearance of these symptoms on the return of an abundant purulent discharge. It is evident that the retention of purulent secretions in parts so near the brain may produce such disturbances.

But even in cases of a favorable termination the ulcers produced by the suppuration, which are disposed to penetrate deep, may lead to caries, and thus blennorrhœa may lead to destructive processes in bone and cartilage, and to corresponding cicatrizations. Purulent catarrh may also lead to chronic rhinitis.

In spite of these various possibilities of an unfavorable termination as regards life or complete recovery, the majority of cases of nasal blennorrhœa, so far as my experience goes, result in perfect restoration to health, even though it may not be until after prolonged treatment.

Diagnosis.

The disease we are now considering, in view of the duration of its purulent secretion, can hardly be confounded with simple coryza. On the other hand, the differential diagnosis between this and diphtheria is often very difficult, and sometimes impossible. We must decide in favor of diphtheria when inspection shows a membranous deposit upon or within the tissues, or when fragments of a pseudomembrane can be demonstrated in the secretion. The mere existence of diphtheria in the neighboring organs is not sufficient proof, for a simple blennorrhœa of the nose may be associated with diphtheria of the pharynx or conjunctiva; but at the same time the occurrence of diphtheria

elsewhere cannot but influence our estimate of the disease in
these cases, nor does it, then, make any difference, in a thera-
peutic point of view, whether in addition to blennorrhœa of the
nasal mucous membrane, it is the seat of a pseudo-membrane or
not.

Greater importance is to be attached to the differential
diagnosis between this disease and affections of the larynx and
deeper respiratory organs. As already stated, it has actually
been confounded with croup, but the resemblance is only very
superficial. The fact that, especially in nurslings, sudden dys-
pnœa and whistling inspiration may be caused by affections of
the nose, together with the existence of disturbances of the nasal
cavity, and the absence of symptoms pointing to the larynx and
the lungs, ought to be enough to guard any one who knows this
from seeking the disease where it does not exist, and overlook-
ing it where it does. We would only further remark in this con-
nection that even before the appearance of any secretion, the
swelling of the mucous membrane may be so great as to result in
complete closure of the nose.

Abscesses of the nose, which will be described below, also
present some points of resemblance to blennorrhœa. The diag-
nosis, however, is settled by the course of the former affection,
in which after several days of inflammatory action, there is sud-
denly a more or less copious discharge of pus, with great relief
to the patient. Blennorrhœa almost invariably involves the
entire mucous membrane of both sides, which is probably never
the case with abscess.

It proves no easy matter in many cases to establish the ori-
gin of gonorrhœal infection. This is not only on account of the
thick vail of secrecy which patients often feel obliged to throw
around the origin of all this class of diseases, but because they
often do not fall under our observation for days and weeks after
infection has taken place. It is well, however, in all cases in
which a purulent discharge from the nose, beginning with in-
flammatory symptoms, lasts some time, to bear in mind the pos-
sibility of the conveyance of gonorrhœal pus to this organ, and
to make inquiries accordingly. Edwards[1] describes the case of

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[1] Lancet, 1857, No. XIV.

a lady suffering from gonorrhœa of the nose, in which some time after the infection he succeeded in proving that she had used a handkerchief which her son, who had the clap, had previously worn as a suspensory bandage.

Treatment.

At the beginning of the disease antiphlogistic procedures are indicated (the use of cold, leeches, etc.). After the appearance of the secretion, our attention must be directed to keeping the nose clean (injections with solutions of carbonate of soda, common salt, etc.) and to limiting the secretion. For the latter purpose the application of astringents, particularly of nitrate of silver in substance or solution (pencilling, injections), is preferable to all other means. As our purpose is merely to produce an astringent effect, not to destroy, we must be careful that the action of the lunar caustic is only superficial ; hence we must not bear on too hard if using the stick, nor make our solutions too strong. Infants must not receive injections into the nose while lying down, as in this position the medicated fluids are very apt to pass through the pharynx into the opening of the larynx, producing severe spasm of the glottis. For the same reason only very small quantities of fluid may be used as injections in infants, and it will be well to do away altogether with the use of Weber's nasal douche.

In discussing the treatment of nasal stenosis above, attention was called to the introduction of elastic tubes into the nose and to the artificial nourishment of infants ; also to the advantage of holding them in an upright posture. We refer to them again here, because these precautions will almost always have to be employed in blennorrhœa. Aside from this, what has just been said, in addition to the principles laid down under the head of general considerations, will be enough to indicate the treatment of the disease. As a prophylactic measure, however, we would strongly commend the value of disinfecting injections (permanganate of potassa) to be thrown into suspected vaginas, before the passage of the head in labor.

DIPHTHERIA OF THE NASAL CAVITY.

Diphtheria of the nasal cavity is very rarely a primary disease. Schuller [1] describes such a case in a boy five weeks old, who had, however, *suffered with coryza from his birth*, and with regard to whom we may therefore remain in doubt whether the pseudo-membranous disease observed might not have developed itself on the foundation of an infection within the maternal vagina. Usually the nasal cavity is only secondarily invaded by diphtheria, and hence we refer, at this time, to the description of the disease as found in the first volume of this Cyclopædia.

ERYSIPELAS OF THE NOSE.

With regard to this affection, too, we refer to the description contained in the second volume. The nose may be invaded by erysipelas spreading from the pharynx or the external skin, or it may itself be the spot which affords entrance to the disease. The diagnosis cannot be positive until erysipelas of the external skin is apparent.

RHINITIS CHRONICA.—OZÆNA.—STOCKSCHNUPFEN.— STINKNASE.

Etiology.

We have already stated that acute rhinitis may pass into the subacute and chronic form, and yet in the vast majority of cases this only takes place in *persons suffering under a dyscrasia. Scrofula and syphilis* are particularly liable to induce this transition. In scrofula a catarrh once set up is liable, in any event, to last longer and to assume a subacute form. If we take into consideration the tendency to relapse peculiar to all scrofulous affections, we can readily see why this dyscrasia in particular

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[1] Jahrb. für Kinderhkde., N. F., IV. Jahrg., 1871, p. 331.

should so readily lead the way from the acute to the chronic form of inflammation. The very succession of appearances found in catarrhs, as described in what has been said, gives us clinical evidence that they emanate from that form of weakness to which we have given the name of scrofula.

The same thing holds good with regard to syphilis (which see). Here the purely irritative beginning of the disease is comparatively rare, a subacute catarrh usually occurring coincidently with other lesions (mucous papules, ulcerations, etc.). But in this dyscrasia, too, there is the most decided tendency in the acute or subacute process to assume a chronic character; and, especially in children, the tendency of acute catarrhs, after many relapses, to pass over into chronic inflammation may be regarded, even in the absence of other symptoms, as indicating the presence of syphilis. Trousseau and Lasègue,[1] in particular, call attention to this.

Although in the majority of cases the development of chronic catarrh from the acute form depends on the existence of a dyscrasia, yet it cannot be denied that *in persons having no dyscrasia*, an acute rhinitis, under bad care, continuance of the irritant, and other injurious influences, may relapse, and finally terminate in the *chronic form*. But, as was stated above, this is comparatively rare. Blennorrhœa more frequently terminates in chronic inflammation.

Aside from any connection with acute processes, we often find chronic inflammation of the mucous membrane with *deeper lesions of the nasal cavity.* Caries of bone, ulcerations, foreign bodies, and abnormal growths within the nose are quite commonly associated with chronic rhinitis. This affection may also arise by communication from a neighboring organ.

Symptoms and Course.

While the manifestations of acute catarrh may be entirely accounted for by the inflammatory processes taking place in the vessels, and their results, chronic inflammation implies the existence of still further changes. Newly developed blood-vessels,

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[1] Archives, 4. série, t. XV., p. 156.

newly developed cellular tissue, and perhaps newly formed lymphatic elements appear.   We. can distinguish two forms of chronic catarrh in the nose : the *hyperplastic and the atrophic forms*.   They often coexist, but in most cases the atrophic form seems to be the result of the hyperplastic ; at least it is most commonly found in old cases, and after the prolonged continuance of the latter form.   In the hypertrophic variety the mucous membrane appears thickened and livid, so that many places in it look like new growths, and as these sometimes occur symmetrically they may even cause some doubts as to their nature in careful observers.   In the atrophic variety, on the contrary, the mucous membrane is thin, often pale, apparently consisting of connective-tissue and blood-vessels alone, and hardly worthy the name of mucous.   In both varieties, however, the epithelial covering undergoes radical changes.   The epithelial cells are partly destroyed, or they become turbid, and the mucous membrane thus loses its natural lustre — it appears opaque and uneven.

The secretion in chronic rhinitis varies very much both in quantity and quality.   There are forms in which the amount produced is very abundant, while others deserve the name of "dry."   The secretion itself is generally of an almost exclusively purulent character.   In many cases it carries enough fluid with it easily to flow away (chronic blennorrhœa) ; but it is often very thick, with a tendency to *form crusts*.   These become firmly attached to the subjacent surface, perhaps owing to the large amount of albumen they contain, and by reason of their wealth of morphological elements (numerous epithelial cells) and their dearth of fluid constituents, are easily dried by the air passing over them.   In general, it may be asserted that the older the affection, and the more it inclines to the atrophic form, the greater will be the tendency of the secretion to dry into crusts.   While we thus account for the retention and the drying of the secretion by its abundance of cells, its paucity of water and its stickiness, there is no doubt that defective cleaning of the nose aids in accomplishing the result.   This may be owing to habitual failure to blow one's nose ; to feebleness of the expiratory current of air at the point affected (stenosis) ; or to diminished reflex irritabil-

ity and the absence of a disposition to sneeze. We cannot, at present, say how far it may be influenced by the possible cessation of ciliary movement.

The crusts present an unnatural, greenish appearance, and if they contain blood, or colored particles adhere to them (soot, paint stuffs, etc.), they may be parti-colored. They vary in size, being usually about that of a silver five- or ten-cent piece, though sometimes they cover an entire turbinated bone like a pseudo-membrane. They are occasionally so firmly adherent to the mucous membrane that they cannot be washed away from it by a stream of water directed against them.

This quality of the secretion gives rise to a phenomenon which imparts a peculiar aspect to chronic rhinitis. By the decomposition which takes place in the secretion a peculiar *stench* is produced, which is communicated to the expired air. This stench, it is true, is of various shades, still it is of a peculiar and specific nature, and is so penetrating that it may often be perceived from afar. It has been compared to the smell of crushed bed-bugs (hence the French name, Punaisie). When this complication appears, chronic rhinitis is called ozæna (from ὄζειν, to stink).

This symptom has received great attention, and all the different conditions under which it appears have been grouped together, as a separate disease, under the name of ozæna. We cannot, however, agree to this, as the stench is merely the result of stagnating and decomposing nasal secretions, and may exist as well in chronic rhinitis as in caries, ulcerations, etc. While this symptom occurs under various conditions—indeed many distinguish between an ozæna ulcerosa and non-ulcerosa—it is not, in spite of its seriousness, worthy of being regarded as a separate disease. To claim the existence of an ozæna without decomposing secretions, as has been done by some writers,[1] seems to me to be contrary to the facts in the case, for the smell is not exhaled by a mucous membrane free from secretion, but it adheres to the secretions, as any one may most readily satisfy himself by a direct examination, and grows less on a diminution

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Compare, among others, *Hedenus*, Deutsche Klinik, 1861, No. 28, S. 269.

of the same.   If a case should come under observation where no
stinking masses could be discovered on inspection, it must be
remembered that all parts of the nose cannot be seen, and that
the smell may also originate in the secretions of neighboring
cavities.

Certain authors have held that ozæna always depends ulti-
mately on some dyscrasia, and it must be remembered that there
are cases in which, for a long time, ozæna is the only symptom
of constitutional or hereditary syphilis.   But there certainly is
such a thing as ozæna not depending on any dyscrasia, and un-
accompanied by deeper lesions of the nose,—one, therefore,
which arises entirely from the retention of adherent and decom-
posing secretions.   There is a young lady at present under my
treatment, with the most well-marked ozæna, in whom the same
offensive greenish crusts, which may be seen in the nose, are
also to be found in the pharynx, in the larynx, and even in the
trachea, and in whose case, in spite of the most careful exami-
nation, no other cause for the condition is to be found than
chronic catarrh, without any dyscrasia.   Unless, then, one is
willing to pronounce in favor of scrofula or syphilis, from the
presence of ozæna alone, in a person giving no other evidence of
a dyscrasia, it will be necessary to admit the existence of *simple
chronic rhinitis with ozæna.*

Still, it cannot be denied that these cases are the more rare
ones, and that ozæna is generally developed after chronic rhinitis
has long persisted in a person who is the subject of a dyscrasia.
During the first period, the duration of which is variable, the
secretions are still fluid enough to be removed.   Later, especi-
ally in the development of the atrophic form of chronic rhinitis,
the formation of crusts occurs, and the remains of hyperplasia
often give rise, at the same time, to stenosis and retention.
According to my observation, this occurs as often in wide,
roomy nasal cavities as in those that are flattened or contracted.
Indeed, in some of these cases the cavity is even exceptionally
wide, probably in consequence of previous long-continued hyper-
plasia.   If, then, under influences thus far unknown, specific
decomposition takes place, the picture of ozæna is completed.
On careful inquiry, the majority of patients suffering from

simple ozæna will admit that, for a long time, indeed, as far back as they can remember, they have very frequently suffered from a cold in the head, that this subsequently developed into chronic catarrh, and that finally the offensive smell appeared.

The *chief annoyance* of patients subject to chronic rhinitis is due, on the one hand, to the swelling and consequent obstruction of the nose as an air-passage (see above), and, on the other hand, if ozæna is present, to the offensive breath. Occasionally patients can perceive the smell themselves; generally, however, they are unable to recognize the foul odor of the air expired, even when their sense of smell, for perfumes existing in the air inspired, still remains. But those who have to deal with a person suffering from ozæna are so annoyed by it that a sensitive patient feels incessantly embarrassed, and some are even driven to a life of solitude. Ozæna not very infrequently interferes with the pursuit of one's avocation in life, and many social and business relations are influenced thereby.

Complications.

Among the first complications of chronic rhinitis to be noticed is its almost invariable predisposition, especially at first, to acute exacerbations. An ulcerative process may also be developed under the crusts; the fluids retained may throw down chalky deposits, and thus form stony concretions; and hyperplasia of the mucous membrane may lead to actual new-formations and polypoid excrescences. As the ulcers alluded to also penetrate deep, and sometimes, after destroying the periosteum, produce caries, it is evident that, just as in the case of occlusion and catarrh (see above, page 110), so here, too, a "vicious circle" is established; all these processes being able to induce chronic rhinitis, and being in turn produced and maintained by that disease. Chronic rhinitis may also involve neighboring parts. It may extend posteriorly into the pharynx, or anteriorly into the epidermis. The cavities adjacent to the nose may also be attacked, and this produces a complication generally hard to diagnosticate and difficult to cure. The most familiar are the processes that take place in the cavity of the upper jaw, which

may thereby be distended and present the affection known as
"Hydrops antri Highmori." The secretions collected in this
cavity sometimes thicken into a syrupy consistence, not infre-
quently disposed in layers, and thus resemble the so-called
"pearl tumors" [cholesteatomata] in appearance. The dis-
tention of the cavity takes place not only toward without, but
also toward the nose, and may thus result in stenosis of an
entire nasal fossa.

The periosteum and perichondrium are involved somewhat
oftener in connection with chronic rhinitis than with acute
catarrh, and yet they are but seldom involved even in the
former affection. In this way caries of the bones may ensue,
even of those belonging to neighboring cavities and entering into
the formation of the base of the cranium. The inflammation is
more likely, however, to spread to the skin surrounding the
nostrils. This becomes infiltrated and swells, while excoriations
of the upper lip, and swelling of the glands of the neck, com-
bine to present a typical picture of "the scrofulous habitus,"
as taught in the schools.

In the majority of cases the sense of smell is either destroyed
or interfered with, and indeed this may prove true where the
remaining conditions for smelling are unchanged.

Diagnosis.

As to the diagnosis of the disease under consideration,
enough guides thereto have been given in the preceding pages.
We would remind our readers of the methods of examination
described under the head of general diagnosis for determining the
spot which is the seat of the foul odor imparted to the breath,
and thus guarding themselves against attributing to the nose
a stench which may originate elsewhere (for instance, in carious
teeth or in collections within the crypts of the tonsils). Inves-
tigation will have to extend beyond the mere diagnosis of
chronic rhinitis, to the etiological grounds, which alone afford
the basis for rational therapeutic interference. And it must
here be remembered that those forms essentially dependent on a
dyscrasia are not to be distinguished from the simple ones by

anything in themselves. The differential diagnosis must be based on the most careful study of the history of the case, and of all its accompanying manifestations. As regards complications a fixed pain in the cheek or the forehead would indicate the implication of the corresponding cavities. Sometimes caries, which was not otherwise to be recognized, is betrayed by the appearance of spiculæ of bone in the secretions on microscopic examination.

Prognosis.

Chronic rhinitis almost always admits of a favorable prognosis as regards life. On the other hand, it is an obstinate evil, often proving very refractory to all attempts at treatment, and sometimes being healed spontaneously. The prognosis becomes more unfavorable in proportion to the chronicity of the cases and the degree to which they have assumed the atrophic form.

Treatment.

In the majority of instances we do not have an opportunity to treat chronic rhinitis until the period for its rapid cure is long past. This is only in part the fault of the laity, for many physicians regard a subacute or chronic nasal catarrh of a child as an ailment that is neither worthy of nor amenable to treatment. Usually friends and physician are satisfied with the diagnosis of a "chronic cold in the head;" the most that may be done will be to order some remedies to combat scrofula, and so the little patient is allowed to become gradually accustomed to having frequent attacks of acute coryza, and, even in his comparatively well days, to having a partially obstructed nose and being obliged to breathe with his mouth open. It is only when the ripening youth, and especially the budding damsel, is attacked with ozæna, that the evil is regarded as one that must by all means be removed. But then, in many cases, it is already too late, and, at all events, much more extensive therapeutic apparatus, and much longer treatment will be required than if one had taken the trouble to subject the rhinitis of the child to the action of local therapeutics. We have already

called attention to the fact that the general condition of children is often improved if we succeed in curing their chronic catarrh. In no case, therefore, should appropriate therapeutic measures be omitted.

In the local treatment of rhinitis our efforts must be directed, first, to loosening the secretions, hastening their removal, and preventing their retention ; second, to restoring the hyperplastic or abnormally secreting mucous membrane to its normal condition ; and third, to removing the stench, if it is present. We have purposely put the cleaning of the nose at the head of the list, because in all cases, even those depending on a dyscrasia, this indication must first be fulfilled.   For this purpose we use, either in the form of douche, injection, or spray (compare General Therapeutics) solutions of common salt, pure carbonate of soda, chlorate of potassa (Siegle), and chloride of ammonium of the strength of from two and a half to ten grains to the ounce. Cousin [1] very properly recommends the addition of glycerine, or the application of glycerine with a brush.

In the use of the douche, which is here most frequently employed, care should be taken, especially at first, not to use too concentrated solutions.   The sensitiveness of the nasal mucous membrane is usually diminished in chronic inflammation ; still there are cases in which it is easily irritated even by the use of weak preparations.   If it is evident, on trial, that the case in hand is not of that character, then we may gradually increase the degree of concentration, always remembering that a portion of the fluid used for a nasal douche is often swallowed, and that there is no denying the possibility of absorption by the nose. The precautions which patients should be instructed to observe in using the nasal douche have already been given in the general portion of this article.   We would repeat, at this point, that the maximum of the pressure to be employed should consist in an elevation of the floor of the cup to a height which the patient can reach by raising his arm.   If only one nasal fossa is clogged or narrowed, it is best to introduce the bulb of the tube into the nostril of that side, as otherwise the return flow through the

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[1] Bullet. de Thérap., 75, p. 504.

nostril may be hindered, and too high a pressure in the pharynx may result. If the douche is not tolerated, injections or the inhalation of atomized fluids (see General Therapeutics) may be ordered.

The second indication must be governed by the etiological conditions. In syphilitic rhinitis, corrosive sublimate (from one-twentieth to one-fourth of a grain to the ounce of water with alcohol or glycerine) used as a douche, or applied with a brush in the strength of from five to ten grains to the ounce will be found of great value. So also (Trousseau) is the snuffing up of a powder of calomel and red precipitate (calomel, forty grains; red oxide of mercury, fifteen grains; white sugar, half an ounce), of which a pinch should be taken five or six times a day. The discoverer of Lugol's solution recommends it in these cases of scrofulous inflammation, and I have found its use, as well as that of the diluted tincture of iodine, especially effective when the circumscribed hyperplasia could be reached with the brush. In cases of chronic rhinitis without any consti-tutional cause, especially in those with a very abundant secre-tion, the entire array of astringent remedies is employed, for par-ticulars concerning the use of which readers are referred to the general portion of this treatise. We may remark, however, that Cazenave particularly recommended nitrate of silver, in sub-stance, in solution applied with a brush, as injections, or as an ointment (one part to twenty of fat). As a snuff, tannin or alum are commonly used, or the two combined, one part to from ten to fifteen of the vehicle (sugar, magnesia, etc.). Borax is also recommended, as well as lead ointment, or pledgets of bibulous paper dipped in lead water.

Circumscribed hyperplasia of the mucous membrane, espe-cially such as causes stenosis, demands vigorous action. Here the use of caustic applications is indicated—nitrate of silver in substance, pencillings with Lugol's solution, tincture of iodine, etc. Galvano-cautery also answers an admirable purpose, either for the removal of the parts involved or as a caustic.

As regards the third indication, we must also refer chiefly to the general observations already alluded to for specific instruc-tions on the use of carbolic acid, permanganate of potassa, and

other disinfectants (chlorinated lime, chlorinated soda, creo-
sote, recommended by Wetzlar[1] in the form of an ointment,
from twenty to forty minims to the ounce of simple cerate).
We must also mention Hedenus'[2] recommendation of the use of
charcoal (animal charcoal, from fifteen to sixty grains; cinchona,
myrrh, each forty grains; cloves, from six to ten grains; or
wood charcoal and myrrh equal parts. A pinch of either of
these snuffs to be taken every hour). But it must be remem-
bered, as was remarked above, that the offensive odor cannot
be cured unless the secretions are removed, and that there-
fore the use of disinfectants is not the primary and radical fea-
ture of treatment. The most that disinfection accomplishes is
the removal of one symptom, though a very prominent and trou-
blesome one, and that only temporarily. This is especially true
of permanganate of potash, which only reaches the surface of
the offensive crust. In addition to these means, therefore, cura-
tive measures fulfilling the other indications must be adopted.

It may be remarked, in conclusion, that the use of astringents
is only indicated as long as swelling of the mucous membrane
and an increase in its secretion is present. The dry and atrophic
forms do not bear astringents, and in them we must confine our-
selves to cleanliness and disinfection.

SUBMUCOUS INFLAMMATION AND ABSCESS OF THE NASAL CAVITY.

The mucous membrane of the nasal cavity lies immediately
upon the periosteum, except that at certain points the venous
cavernous bodies already alluded to intervene. True phlegmon-
ous inflammation of the nose, therefore, can hardly exist. Still,
acute inflammations, similar to those of a phlegmonous character,
do arise here, though very rarely, involving the deeper layers of
the mucous membrane and the periosteum. Such inflammations
are encountered particularly after traumatic injuries to the nose;

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[1] Arch. f. Chir., I., S. 246.

[2] L. c., 270.

they may, however, be associated with catarrh or blennorrhœa, or depend on rheumatic causes, or even appear without any demonstrable cause.

In the epidermoid portion of the lining of the nose, which is supplied with vibrissæ, therefore, in the neighborhood of the nostrils, inflammations resembling acne or furuncles (in their nature and course) may arise, which lead to circumscribed abscesses.

Symptoms.

A circumscribed inflammation is liable to arise within the nasal cavity, usually attacking only one side, but sometimes symmetrical portions of the septum. The swelling of the mucous membrane is very great, it is pouched out "like a sac," and may even, according to Barthez and Rilliet[1] and Henoch,[2] project from the nostrils as a polypoid tumor. The mucous membrane is highly reddened, and fluctuating to the touch. At the same time there is œdematous swelling of the external skin, even of the skin of the face, and sometimes of the lower eyelids. Patients complain of severe pain in the nose ; if the upper part is attacked, also of pain in the forehead, or if the lateral portion, of pain in the cheek. The discharge from the nose is sometimes normal, at others more or less increased, and in the latter case usually purulent. A serious degree of fever is always associated with this condition, and at times severe brain symptoms appear. Leisring[3] describes a case, which is of great interest not only on account of the wide extent of the inflammation, but also because on the dead body it was demonstrated that the trouble had extended to the meninges of the brain.

An inflammation developing into gangrene arose in the mucous and periosteal covering of the right nasal fossa in a strong man. It may have been caused by inflammation of the antrum of Highmore, following unsuccessful attempts at the extraction of a tooth. In the left cavity only the bony septum was attacked. On the eleventh day the patient began to squint and to vomit; grew stupid and died, with evidences of meningitis. Post-mortem examination revealed purulent menin-

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[1] Arch. f. Chir., I., S. 196.

[2] L. c., S. 29.

[3] Deutsche Klinik, 70, S. 129.

gitis of the right side. The bones of the middle meatus and the ethmoid bone were colored grayish-green. The mucous membrane of the bony septum of the antrum of Highmore, of the cavities of the sphenoid, and of the ethmoidal cells were colored grayish-green, and covered with a purulent coating. The mucous membrane of the bony septum was detached by purulent masses, which had in part already become cheesy.

Diagnosis.

The diagnosis of this affection, especially as regards its location, is at first not easy, and can only be made positive when a fluctuating swelling can be demonstrated. Œdematous swelling of the face may be taken as confirmatory of the diagnosis.

Termination.

The *course* of this affection is usually rapid, a ripe abscess appearing at the end of a few days. The spontaneous or artificial opening of the same, through the mucous membrane, brings the patient speedy relief, and usually leads to a rapid cure. In the furuncular form plugs are expelled or extracted.

The *prognosis* is not always favorable, although cases in which extension to the dura mater, or venous thrombosis and embolism occur, are among the greatest rarities. The disease generally ends in recovery, but sometimes caries remains, probably as evidence that the disturbance originated in the bone or its adnexa.

Treatment.

Antiphlogistic means (leeches, cold, etc.) should be tried at the beginning. As soon as we can diagnosticate an abscess in process of formation our aim should be to favor its maturing (by the inhalation of warm vapor, etc.) and its opening.

ULCERATIONS OF THE NASAL CAVITY.

Etiology.

The ulcerations that occur in *syphilis* and in *glanders* have

already been treated of in the third volume of this Cyclopædia, at pages 207 and 356, as well as 359 and 362.   If we except those dependent on *caries of bone* and the extension of *lupus* on to the mucous membrane (which see) there only remain for our consideration those ulcerations of the nose which are *catarrhal* or *scrofulous.*   Tubercular (phthisical) ulcers of the nose seem to be among the greatest of rarities.   I myself have never seen anything like them, and only find one allusion to tuberculosis of the nose in literature.   Willigk[1] states that in the Institute of Pathological Anatomy at Prague, tuberculosis of the nasal septum was encountered but once among the 476 tubercular corpses found in 1,600 post-mortems, made from February 1st, 1850, to February 1st, 1852.   With regard to the origin of ulcers, it has already been stated that they may result from superficial losses of substance in the epithelium, at first flat and circumscribed, and especially liable to be formed underneath encrusted secretions.   Not only in syphilitic subjects, but in scrofulous individuals as well, such little ulcers sometimes have a tendency to penetrate deeply, and finally even to attack and destroy the bony walls so that they may result in extensive losses of substance in the gums, the septum, and the turbinated bones.   Although such extreme forms are not frequent, yet they do certainly occur,[2] and one is therefore not justified in pronouncing in favor of constitutional syphilis exclusively on the ground of such ulcerations and defects.   This conclusion is still less justifiable in the case of children, because even primary diseases of the bones and their adnexa may lead to the same results.

Diagnosis.—Treatment.

The diagnosis of these cases is easy, so far as the eye is concerned, and the question of the implication of the bony structure is readily determined by touch with the finger or a sound.   It is a much more difficult matter, however, to decide whether the local process, so easily recognized, is of purely irritative origin, or

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[1] Prager Vierteljahrschrift, Bd. 38, S. 4.

[2] Compare, for instance, *Semeleder*, Rhinoscopie, S. 55, Beobachtg. 21, with illustration.

dependent on syphilis or scrofula. With the same appearance
of the local manifestations we can only arrive at a diagnosis by
careful sifting of the history, and by exclusion and a comparison
of the appearances in other organs. Finally, in the light of all
these aids, we must endeavor to arrive at a conclusion.

Treatment is directed on the one hand to the general ailment,
and on the other to surgical manipulations and the topical appli-
cation of caustics and astringents. The chronic rhinitis which
complicates these cases is to be treated in accordance with the
principles set forth above.

NOSEBLEED.—EPISTAXIS.

Etiology.

Hemorrhages from the nose are of very common occurrence,
and may depend on a variety of causes. In this connection we
may remind our readers of the great wealth of blood-vessels,
and the peculiar arrangement of the vessels within the nose,
already spoken of above (p. 123). The nasal mucous membrane
is thus endowed with a great tendency to bleeding, and is the
organ most frequently subject to spontaneous hemorrhage.
Nosebleed is of such common occurrence that few men remain
free from it through life. At the same time there is no denying
the fact that certain individuals possess a nasal mucous mem-
brane peculiarly predisposed to hemorrhage, in whom more or
less serious bleeding may be caused by etiological conditions
which would produce no effect on the majority of mankind.

Epistaxis may be arranged under two general heads, accord-
ing as it occurs spontaneously or follows traumatic injuries.
Under the latter head it may be occasioned by mechanical vio-
lence as well to the outside of the nose and its surroundings as
to the mucous membrane itself. In persons who are predisposed
that way, hemorrhage may be caused by a degree of violence so
slight as hardly to be worth mentioning, such as touching the
mucous membrane with the finger or a sound, blowing the nose,
etc.

Spontaneous nosebleed depends primarily on local causes *situated within the nose.* All the conditions already mentioned, and we may say all diseases of the nose, may be associated with hemorrhage. As a matter of course, ulcers involving the walls of blood-vessels, and all those acute diseases characterized by hyperæmia, are most liable to lead to hemorrhage, and therefore it is seldom absent in severe coryza or in erysipelatous and other inflammations.

Special mention must also be made of vascular polypi, as they manifest a very marked tendency to hemorrhage.[1]

Aside from local causes, however, spontaneous nosebleed may also depend on manifold etiological conditions. The first to be considered are those diseases which give rise to a *hemorrhagic diathesis*, and to hemorrhage in various organs, such as purpura hæmorrhagica, scurvy, variola hæmorrhagica, leukæmia,[2] hæmatophilia, etc. In all these nosebleed is among the commonest occurrences. We must further mention those conditions in which the *lateral pressure* within the blood-vessels in the nose is altered, such, for instance, as hinder the flow of blood through the veins, or increase the pressure within the arterial system. Tumors of the neck, or whooping-cough, with its paroxysms of asphyxia, which suffice to induce stagnation in the superior vena cava, may be enumerated among the first, while contraction of the kidney, with hypertrophy of the left ventricle, serves as an example of the second. Epistaxis is therefore a frequent symptom in threatened uræmic attacks. The nosebleed that occurs during the ascent of high mountains, and which is due to the low state of the barometer, may also here be mentioned.

Nosebleed also occurs in the various *infectious diseases*, as has already been mentioned in this Cyclopædia, in connection with variola, influenza, measles, scarlatina, typhus, etc. It is found, though but rarely, in acute tuberculosis, trichinosis, and many other conditions. In these affections it may take place

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[1] Compare *Virchow*, Geschwülste, Bd. III., S. 463.

[2] *Mosler*, Leukaemie. Berlin, 1872. (In eighty-one cases there were sixty-four hemorrhages, thirty-five of which were from the nose.)

at the beginning, during their course, or introducing a crisis.   It
also sometimes occurs during an attack of intermittent fever,
and intermittent epistaxis without fever has also been observed,
and cured by quinine.   *Diseases of the spleen* are often cited as
a cause of epistaxis, doubtless because alterations in the spleen
accompany all the diseases just mentioned.

Epistaxis is worthy of special attention when, without any
local cause, it recurs frequently in the same individual, and
becomes, so to speak, *habitual*.   It may appear *vicariously* for
other customary hemorrhages, especially for those of a hemor-
rhoidal character or in place of menstruation, and in both cases
may return at regular intervals.   It is of the most interest when
appearing in the place of menstruation.   The nosebleed may
occur simultaneously with diminished menstruation or without
any flow of blood from the genitals.   Even in the latter case, in
spite of the complete absence of menstrual bleeding, conception
is possible.   Among the cases described, we may notice that
Kussmaul [1] observed regularly recurring epistaxis in a woman
having no uterus, but in this case he expresses doubts as to its
menstrual character.   In the case of a girl, nineteen years old,
who had never menstruated, Fricker [2] saw nosebleed, with the
menstrual molimina, recur every six weeks, and the loss of blood
was so excessive that the patient finally succumbed to it.   In a
woman who was pregnant for the fifth time, Sommer [3] observed
epistaxis recurring once a month during her entire pregnancy,
and always lasting for one day.   Nosebleed may also occur at
regular intervals in persons suffering from leukæmia, and in
women may assume the menstrual type. [4]   A case was observed
by Otto Obermeier, [5] in the Insane Division of the Charité Hos-
pital, which is so characteristic of these conditions that we will
quote the following portions of his description verbally :

" The patient had one period of menstruation at the age of fifteen.   It was ac-
companied by feelings of drawing within the abdomen, and of bearing down; there

[1] *Kussmaul*, Vom Mangel der Gebärmutter.   Würzburg, 1859.

[2] Würtemberg. Med. Correspond., 1844, No. 21.

[3] Heidelberger Ann., X., 3.

[4] *Mosler*, Leukämie, S. 174.

[5] Virchow's Arch., Bd. LIV., S. 435.

was no other pain nor dizziness. The loss of blood was very considerable during one night, so that it soaked through the bed. She was somewhat unwell for the next two days, but lost no more blood. Four weeks later she had the same feelings within the abdomen; and when she went up stairs, in particular, felt as if something would fall out between her feet. But there was no escape of blood from the genitals, and never has been, up to the present time. Instead of this, hemorrhage from the nose appeared, recurring several times a day for three days. During the first day she still had a general sick feeling, a sensation of dizziness, and things were black before her eyes. From this time on this nosebleed recurred every four weeks, at first regularly, varying perhaps one day, accompanied by the same symptoms, and continuing for three days. The loss of blood at each hemorrhage amounted to about a teacupful, and took place from one to three times a day. The feeling of dragging within the body, and of dizziness was always present the first day; at the same time her limbs were tremulous, and she was giddy, felt as if everything was spinning round her, or, as she herself expressed it, 'as if she were riding in a merry-go-round.' She used to be obliged to sit down, though she never fell, and never lost her consciousness. There never was any appearance of a flow from the genitals during the menstrual period. In March, 1870, this periodical nosebleed stopped. In December of the same year she was delivered. (The child was well developed, and died at the age of six months of croup.) During the pregnancy, which commenced in March, she often vomited after eating, from the fourth month to the time of her confinement. At the same time she had an unnatural craving for herring and cucumbers. Six weeks after her confinement, in January, the nosebleed returned, with the same symptoms, but it was more scanty, and did not last exactly three days, but distributed itself over a period of eight days. It returned about once in four weeks, and was last seen the beginning of August. She believes she has been pregnant since that time, and an examination confirms the belief."

According to Puech,[1] among the regions of the body liable to be the seat of vicarious hemorrhage in the place of menstruation, the nasal mucous membrane ranks last in the frequency with which it thus acts. According to his observations, such vicarious hemorrhage occurred thirty-two times from the stomach, twenty-five times from the breasts, twenty-four times from the lungs, and only eighteen times from the nasal mucous membrane.

We shall have to be cautious in assigning a vicarious character to hemorrhages, as many an accidental flow may have the semblance of being such, without there existing, in reality, any etiological connection between the suppression of one hemorrhage and the appearance of another. But that such a thing

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[1] Gaz. des hôpit., 1863, p. 188.

does take place can hardly be doubted, in view of the observations that have been made, and especially of Obermeier's case, as communicated above.

Aside, however, from this nasal hemorrhage, which may, or must be regarded as vicarious for some other customary flow of blood, *habitual nosebleed* is of tolerably frequent occurrence, showing itself in persons of every age, but more particularly during the development of puberty, and especially in the male sex. Those attacked are otherwise sometimes in quite normal condition, sometimes bursting with blood, and generally plethoric, at others decidedly anæmic. The bleeding may arise either with or without an exciting cause.

Epistaxis sometimes occurs daily, sometimes at longer intervals, and these intervals, as has already been said, may for a long time recur with more or less regular periodicity, presenting the appearance of a vicarious hemorrhage. In many cases, especially in plethoric persons, the accompanying symptoms (see below) give the epistaxis a decidedly fluxionary character; in others, such symptoms are lacking, and we must then suppose that there are alterations in the walls of the vessels, of which we know nothing more specific.

Habitual nosebleed is *hereditary* in some families. Babington[1] describes a marked case of this kind.

A woman who suffered from habitual nosebleed had six female children, three of whom also suffered from epistaxis; one of these also had six children, of which the two female ones were affected in the same way. The older of these two last had a son living who was similarly troubled. The sister of the woman first mentioned likewise has a daughter living who is subject to violent nosebleed. Here the presence of severe epistaxis is demonstrated down to the fifth generation, Babington himself having witnessed it in the mother, daughter, and grandchild. In the latter the attacks were so severe that the tampon had to be used every time.

It may be worthy of mention that Morgagni,[2] in accordance with a tradition of his native country, alludes to an *epidemic of nosebleed* which is said to have prevailed in Etruria and the Romandiola in the year 1200, and which is reported to have been fatal within twenty-four hours, and to have carried off many

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[1] Lancet, 1865, II., No. 13.
[2] De sedibus. Leipzig, 1827, XIV., 25, tom. I., p. 414.

of the inhabitants. Nothing more specific appears from the description, and nothing like it is reported anywhere else.

Symptoms.

Hemorrhage from the nose usually takes place from one nostril only, and it is claimed that in affections of the spleen the left nostril is more frequently affected than the right. Still, even with diseases of the spleen, hemorrhage may arise from both sides, or even from the right side only.

The *amount* of the hemorrhage is very variable. Sometimes but a few drops escape; generally, however, there is a pretty rapid dripping, and it is not uncommon to see an uninterrupted stream poured forth at the very beginning. It is extremely rare for the blood to flow in jets.

The *duration* of the flow is equally variable. While the bleeding is sometimes confined to a few seconds, it may at other times last for hours, and even days. The *total quantity* of blood lost at each attack must necessarily vary very much according to the duration and the rapidity of the flow, running from a few drops or a few teaspoonfuls, or tablespoonfuls, up to enormous quantities. Johann Peter Frank[1] states that during a prolonged hemorrhage, at one time "six pounds escaped within a little while." Martineau[2] saw a case in which 4,500 grammes of blood (twelve pounds) were lost within sixty hours, and another case is reported in which, little by little, seventy-five pounds of blood escaped through the nose. Hemorrhage dependent on traumatic causes or diseases of the nose is much less likely to be accompanied by an abundant flow than that which is caused by other conditions.

The blood is generally clean, and, if it has not been retained long in the nose, is of a bright red *color*. It presents no special peculiarities as compared with the general blood of the individual concerned. Under certain complications it may be mingled with mucus or pus. It coagulates as readily as the general blood of the person attacked. Sometimes clots form before it

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[1] *J. P. Frank*, Grundstäze, u. s. w. Mannheim, 1807, VI., S. 135.

[2] Union méd., 1868, No. 104.

escapes from the nose, and plugs of clotted blood similar to polypi may protrude from the nostrils.

In severe hemorrhage there is not only a flow from the nostril of the side attacked, but the entire cavity of the nose and the naso-pharyngeal space are filled. In this way *a flow from the healthy side, as well as into the throat,* may result. Thus, epistaxis of one side may appear to be double, and blood may also escape from the mouth. When nosebleed occurs in persons who are asleep, or otherwise unconscious, a part of the blood that reaches the pharynx is generally swallowed or passes into the trachea, and may then be vomited or coughed up.

From these manifestations we may conclude that at least the severer hemorrhages are due to openings that are developed in the blood-vessels which anastomose and dilate into cavernous bodies, the blood pouring out at these openings. Severe hemorrhages can hardly be explained without a *solution of continuity in the walls of the vessels.* Probably smaller vessels are ruptured. We have as yet no anatomical investigations to prove whether, in certain forms of habitual nosebleed, the walls of the vessels undergo a previous change, such as varicose degeneration.

In many cases, and especially those of habitual epistaxis, there are certain *premonitory signs.* They are appearances, as was indicated above, which may be regarded as evidence of the fluxionary character of these hemorrhages.

They usually consist of symptoms which prove that not only the nose, but the whole half of the head, in fact, the entire head, is the seat of an active hyperæmia. Among the objective signs are redness of the cheeks and of the head, as well as injection of the conjunctiva, sometimes only of one side. Patients complain of great pressure within the head, sometimes of dizziness, drowsiness, roaring or ringing in the ears, throbbing in the head, and a feeling of fulness, distention, and warmth within the nose. J. P. Frank's statement that sometimes a dicrotic pulse appeared in only one radial artery, has not been confirmed. These manifestations vary considerably in different people, but they are usually repeated with great regularity in the same person, so that they know when they are about to be attacked with epistaxis. The premonitory symptoms are so burdensome that

patients long for the appearance of the hemorrhage; they greet it with joy, and often try to induce it artificially. For, with the appearance of bleeding, these unpleasant symptoms abate, especially the headache; and it is therefore very natural that people thus attacked should regard the nose as a safety-valve against hemorrhage of the brain or of other important organs.

Course.

Left to itself the hemorrhage either stops without any further sign—consequently by closure of the openings in the vessels—or clots are formed within the cavity of the nose, gradually producing thrombosis of that cavity and of the calibre of the vessels. In the latter case it is not uncommon for such plugs to be expelled from the nostrils or driven into the posterior nares by the pressure of the blood behind them, and then for the hemorrhage, which had apparently stopped, to begin again with violence. The same thing may naturally also sometimes occur when the plugs are artificially removed, or come away on blowing one's nose or sneezing.

In nosebleed, where the flow is rapid, evidences of *acute anæmia* may arise, as in all other sudden losses of blood, and death from hemorrhage may finally result. Roaring in the ears, a small pulse, fainting, etc., in such cases, are symptoms worthy of the most careful attention. Frequent epistaxis may also materially affect the general condition. Evidences of *chronic anæmia* appear, and hemorrhages in other organs may be caused thereby, so that finally it seems as if one might have been dealing with a hemorrhagic diathesis from the beginning.

Even when clots prevent the escape of blood from the nostrils, a continuation of the flow may be going on posteriorly. If, in such cases, the patient swallows the blood that flows into the pharynx, the most serious danger may arise, while to all appearances the hemorrhage has ceased.

Fainting during a nosebleed is especially dangerous, for the reason that blood may pass into the trachea and cause asphyxia. The same danger exists at all times in persons who are unconscious, as is well known to be the case in patients who, while

under the influence of chloroform, are subjected to operations in
the mouth, the pharynx, etc.

Prognosis.

The pathological dignity of nosebleed depends on the quan-
tity of blood lost, and the frequency with which these losses
recur.   It is a matter of course that very slight hemorrhages are
only of importance if they are repeated very frequently, and
that the prognosis of epistaxis will have to be determined
in accordance with these facts.   In the vast majority of cases
nosebleed terminates favorably, either with or without artificial
aid ; it is but seldom that fainting, prolonged anæmia, or even
death follows a single hemorrhage of uncommon severity or a
prolonged flow.   Some authors speak of disturbances of diges-
tion supposed to be due to the blood swallowed.

Habitual epistaxis during youth is regarded as an occurrence
of ill omen by some writers, because they consider it as
an introduction to future pneumorrhagia preceding pulmonary
phthisis.   I cannot coincide with this view.   It is true that
habitual epistaxis is not infrequently met with in delicate
persons, who easily become anæmic, and that some phthisical
patients prove to have formerly suffered from nosebleed.   But
this question, addressed to pulmonary consumptives, even to
those who have suffered from hæmoptysis, is at least as often
answered in the negative.   But what is of more importance is
the fact, according to my observation, that the vast majority
of those who suffer from epistaxis during their adolescent
years do not develop phthisis.   If a causal connection between
phthisis and epistaxis is to be established, it will have to be con-
fined to this, that habitual nosebleed, just like all other weaken-
ing influences, may occasion phthisis in persons predisposed
thereto.

Diagnosis.

As regards diagnosis, it is usually a very easy matter, the fol-
lowing points only requiring to be observed.   We must reserve
the name epistaxis for those cases in which the nasal mucous

membrane itself, and its vessels, are the seat of the hemorrhage. We must therefore endeavor to exclude all hemorrhages originating in another organ which empty themselves through the nose. The hemorrhages which will most frequently have to be thus distinguished are those of the naso-pharyngeal space and neighboring organs, and it may be mentioned that Köppe[1] has observed nosebleed that originated in the transverse sinus, and, there being disease of the cavity of the tympanum, was discharged simultaneously through the nose and the external auditory canal. Hemorrhage of the air-passages or of the stomach, when coughing or vomiting takes place, may at the same time be discharged from the nostrils. On the other hand, however, as was intimated above, true epistaxis may simulate hemorrhage of the throat, of the air-passages, or of the stomach.

The differential diagnosis in these cases is easy, if one sees the patient during the hemorrhage. Direct inspection of the pharynx, through the mouth, at least settles the question, at once, whether the bleeding is from the nose and the naso-pharyngeal space or from the deeper respiratory or digestive organs. Cases which are not seen until after hemorrhage has ceased present greater difficulty. It will be necessary in such cases to try to determine the seat of hemorrhage by the more or less firm attachment of the coagula. But there are cases in which hemorrhage stops without the formation of clots, and in which none are to be seen immediately after the cessation of the bleeding ; we are then obliged to deduce our conclusions, with greater or less accuracy, from the statements of the patient, or of those about him, just as we have to do in those cases that come to us still later, and where we have nothing but the history of the case to guide us. Under such circumstances we must remember that in the vast majority of cases of hemorrhage through the nostrils the nose is the part affected, and that hemorrhages from the respiratory organs or the stomach, escaping at the same time from mouth and nostrils, are always very profuse, and could hardly occur without other characteristic indications of the disease which occasioned them. Hemorrhages of that kind are not likely to be mistaken for nosebleed,

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[1] Arch. f. Ohrenhlkde., Bd. II., S. 181.

whereas, on the contrary, epistaxis may be confounded with hemorrhage from the lungs or stomach, though even this is not very frequent. The cases that are thus confounded are usually those of hemorrhage from the posterior parts, taking place during sleep, in which the patient, to his great alarm, spits up considerable quantities of blood on awaking, without being conscious of any nosebleed, and, in fact, without having had any blood escape at the nostrils. If, in such cases, one has a chance to see the patient soon afterwards, one will usually find clots of blood more or less firmly adherent to the nasal or naso-pharyngeal cavities, and thus be enabled to confirm the diagnosis. At a later date, either the absence of severe illness, or the repetition of similar hemorrhages, giving evidence of their nasal origin, furnishes us with a basis for diagnostic conclusions.

In many instances it is very difficult to determine whether the hemorrhage originates in the naso-pharyngeal space, the posterior, or some other portion of the nose. If there is any considerable flow of blood it is generally impossible by rhinoscopy or inspection from in front to determine the bleeding-point, because the entire field of vision is obscured by blood. We may suppose a hemorrhage to come from the naso-pharyngeal space if it likewise involves the ear, and we may set it down as coming from the front part of the nose if we can stop the bleeding or prevent its further flow posteriorly by pressing the upper part of the alæ of the nose against the septum. This will be referred to again under the head of therapeutics.

Treatment.

Under this head we will first consider the therapeutic means to be employed against the hemorrhage itself, and we are obliged at the outset to inquire *whether, on the whole, we wish to arrest this or not.* As a matter of course we do not now refer to those cases of nosebleed, in which the bleeding is so scanty and of so short duration that neither patient nor physician thinks of such a thing as therapeutic interference, but to such as show a more abundant hemorrhage, and in which, at the same time, one has every reason to regard the nosebleed as evidence of hyperæmia

of the head which Nature is thus seeking to relieve. Such cases occur, not only in habitual nosebleed, but also sometimes in the course of acute disease. The same question will arise in connection with vicarious epistaxis. In all these combinations, however, we shall have to try to arrest the hemorrhage as soon as by its severity, or the frequency of its recurrence, it begins to produce symptoms of acute or chronic anæmia. In these cases of epistaxis, but in no others, it will be permissible to wait up to that point, without doing anything, as experience shows that the loss of blood affords relief; but as soon as the hemorrhage seems to be dangerous we must take means to stop it, even in fluxionary or vicarious cases, and this is all the more imperative, as no well-authenticated instances are on hand of evil results following a suppressed nosebleed.

In every epistaxis that is at all considerable, it is well first to try to arrest the hemorrhage by external pressure. Either the physician or the patient should press the ala of the side affected, at the incisura pyriformis, against the septum in such a manner as to close the nostril and the front and upper part of the nose. This is for the purpose of causing coagulation of the blood, which may then serve as a tampon to the cavity, and lead to closure of the bleeding vessels. The patient must at the same time be brought into the most perfect possible state of rest of mind and body, removed from any anxious surroundings, and encouraged to breathe as quietly as possible without speaking or blowing his nose. It is also desirable to assign to him a certain posture, and the best one will be to let him sit upright, with his head inclined slightly forward, "as if he were about to write."[1] In this position the floor of the nasal cavity, which when the head is held erect inclines to the rear, is changed to a horizontal plane, and it is made more difficult for the blood to flow back down the throat. As a matter of course, all articles of clothing that prevent the return flow of blood from the head (tight neckties, etc.) must be removed.

Instead of external compression, Valsalva, as described by Morgagni,[2] applied pressure *by means of a finger introduced into the nostril.* Valsalva believed it possible to reach and com-

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[1] *Hiard*, Gazette des Hôp., 1861, p. 379.   [2] L c. IV., S. 411.

press the bleeding vessels by the finger, and in the case referred
to by Morgagni, in which Valsalva applied this "fortunate
cure" against an otherwise uncontrollable nosebleed, the patient
learned to introduce his own finger in this way and stop the
bleeding. There is no denying the fact that the finger thus
introduced may often effect compression and occlusion of the
anterior nasal region, reaching a point higher up than can be
reached from without.

Instead of employing external compression, it is in many
cases far easier to fill out the anterior region of the nose with a
pledget of picked lint introduced through the nostril. Such an
"anterior tampon" is also far pleasanter to the patient than
pressure by the finger over the external skin, if it has to be
continued long. The bunch of charpie is to be previously tied
together with a firm thread, so that by drawing on this thread
which is left hanging out of the nostril, the whole of it can be
withdrawn at once.

By such procedures it is possible, in a great many cases, to
arrest the hemorrhage, as already intimated, by causing the for-
mation of coagula in that part of the nasal cavity which is thus
shut off, and so effecting the closure of the bleeding vessels.
This is true with regard to those cases, constituting the majority
of all nosebleeds, in which the hemorrhage originates in that
region ; and, on the other hand, we may ascertain by the results
of this method of treatment whether we are dealing with that
kind of a case, or not. When using external compression or the
anterior tampon, we should also direct our attention to the ques-
tion of whether the hemorrhage is not continuing into the phar-
ynx, and, if the sensations or testimony of the patient are at all
doubtful, we must satisfy ourselves with regard to it by ocular
inspection. If we succeed by such means in preventing the
escape of blood through the posterior nares, it is evidence that
the bleeding is from the anterior nasal region, and we have every
prospect that by means of sufficiently prolonged and systematic
compression—during which, as the flow is stopped, nothing is
being lost—the hemorrhage may be definitely arrested. For in
these cases success depends upon giving the coagulated blood
time enough to form firm clots.

As an adjunct to these means we may employ compression of the carotid, which may be carried out in conjunction with a method of tamponing to be described below.

If the foregoing means are not sufficient to prevent the escape of blood posteriorly, an array of more or less empirical methods may be tried next. First of all we will speak of the application of cold, both in the form of compresses over the nose, and in that of pouring or injecting cold water into the nasal cavity. The latter method has the disadvantage that, although contrac tion of the vessels is excited, the coagulation of the blood is hindered, and even clots that are already formed may be washed away. This occurs most frequently if one permits the patient to snuff up the cold water held in his hand, as the suction movements thus occasioned are often capable of exciting the bleeding again.

We may also employ cold solutions of *astringent drugs* (alum, tannin, sulphate of zinc, singly or in combination, the solution of chloride of iron, nitrate of silver, alcohol, vinegar, and many others). Notwithstanding the great efficacy of these means, if one can recognize the bleeding point, and bring it into direct contact with concentrated solutions, or with the article in substance, I have seldom seen any good from their use in the weak solutions ordinarily employed, solutions the strength of which is dictated by a proper regard for the non-bleeding portion of the mucous membrane.

Manipulations calculated to produce spasm of the vessels through reflex action have also been recommended, not only by the laity but by trustworthy authors. The principal means of this sort is the application of cold to distant organs—to the neck for instance, but particularly to the scrotum in men, and in women to the breasts. The laity often try the effect of frighten ing patients, for the purpose of thus producing contraction of the vessels. In this connection it may be remarked that Macnamara[1] cites several cases in which mental disturbances were the cause of severe epistaxis.

In active forms of nosebleed, *derivatives* may be tried—dry

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[1] Dublin Jour., Vol. XXXIII., p. 43.

cups to the neck, mustard foot-baths, or even a slight with-
drawal of blood from other parts.   Venesection, which was
formerly recommended in this affection, is not to be employed,
owing to the increased danger of anæmia.   Négrier advises ele-
vating the arms, in addition to compression.

It may be laid down as a general rule that *too much time
must not be lost in the trial of these methods*.   Experience
teaches that truly severe epistaxis grows more severe and
harder to control with its increased duration.   Therefore we
should rely on the above means only so long as no danger from
anæmia can be discovered.   As soon as the slightest evidence of
such danger appears, or if we have special reason to dread hem-
orrhage on account of the constitution of the patient, we must
give up dependence on all such means as soon as it is established
that external pressure and the anterior tampon are unavailing,
and must turn to the sovereign remedy, by which the great
majority of all nasal hemorrhages may be arrested, viz., *plug-
ging the posterior nares*.   The simplest method of effecting this,
with Belloc's canula or the rhineurynter, has been described
under the head of general therapeutics.   As a matter of course,
the tampon introduced must be large enough really to fill the
posterior nares.   At the same time the anterior part of the nose
must be plugged.   If no Belloc's canula is at hand, a piece of
gum-elastic catheter may be used, being passed through the
nostril into the oral portion of the pharynx, then seized with
forceps and brought out at the mouth for the purpose of attach-
ing the tampon thereto.   In the place of the rhineurynter, J. P.
Frank[1] improvised a procedure which entitles him to be regarded
as the actual inventor of the instrument—priority in the use of
which has been a subject of contention among some of our con-
temporaries.   Frank, with the aid of a probe, introduces into the
bleeding nostril a moistened piece of hog's intestine which has
been dried in the air, and one end of which is tied with a fine
thread.   This being accomplished, cold water is injected into the
opening of the intestine outside of the nose, and so a complete
filling of the nose is accomplished.   If no syringe is at hand,

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[1] L. c., VI. Bd., p. 145.

the gut can be inflated with air. After it is filled, the outer extremity, too, is tied.

In place of plugging the posterior nares, many authors recommend *the introduction into the nose*, as far back as the pharynx, *of wicks capable of absorbing fluids*. Thompson,[1] Josiah Smyly,[2] and many others, advise, for the carrying out of this method, which was employed by the ancients, the introduction of strips of linen into the lower nasal canal. It is not to be denied that plugging the posterior nares is a tolerably disagreeable procedure for the patient, and that the filling up of the nasal cavity causes less even of the feeling of pressure and of the presence of a foreign body, which makes itself felt in a very disturbing manner on the introduction of a tampon from the pharynx. But the introduction of wicks is a less certain measure, and although it succeeds in many cases, and may therefore be tried, yet the operation of plugging the posterior nares should not be laid on the shelf, merely out of regard to the comfort of patients, nor turned to merely as a last resort in rare cases. Here again the statement made above is to be remembered, namely, that epistaxis is always more difficult to arrest when it has been of long duration.

The proposition to introduce bibulous substances into the nose is based on the same theory as tamponing, the idea being to induce a coagulation of blood sufficient to fill the entire cavity, and finally to close the bleeding vessels. The wicks are expected to be soaked with blood, the blood to coagulate within them, and then a progressive coagulation to go on till the end is accomplished. For the sake of encouraging this coagulation some writers put astringents on the wicks before introducing them. Curtin[3] sprinkles them with tannin; Gilruth[4] dips them in chloride of iron. But Frank thinks that in such cases the compression of the parts by means of the tampons is often more effective than the styptics, and recommends, therefore, that if

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[1] Brit. Med. Journ., 1867, No. 361.

[2] In Macnamara, l. c., p. 54.

[3] Phila. Med. Times, Aug. 1st, 1872.

[4] The Lancet, 1871 (Dec. 2), II., p. 775.

one wick is not sufficient, a thicker one and one better twisted
be taken, which usually proves sufficient of itself to arrest
hemorrhage.

The tampons, wicks, or whatever has been used, whether
introduced from before or behind, *must be removed from the
nose* as soon as a bad smell attaches itself to the coagula. This
is usually the case at the end of twenty-four hours, and in the
vast majority of instances a tampon remaining in position for
that length of time permanently arrests the hemorrhage. It
hardly ever happens, except in case of a general hemorrhagic
diathesis, that epistaxis recurs after a tampon has been applied
for twenty-four hours. If it does, new tampons must be used.

To facilitate the removal of a tampon the nose may be irri-
gated with a five-grain solution of common salt or of carbonate
of soda, which is cool, that is, neither lukewarm nor cold, care
being taken to employ as low a pressure as possible. In addi-
tion to the thread which passes out at the nose (in the case of
a tampon introduced posteriorly), it is well to attach a second
thread, which latter is to be brought out at the mouth, and to
be used, if necessary, for the removal of the tampon. It is
true that this thread may sometimes annoy the patient not a
little, and is often superfluous. For, after loosening the thread
brought out at the nostril, and usually fastened to the ear, a
stream of water of very slight pressure, but of sufficient duration,
is generally enough to loosen the tampon and carry it into the
naso-pharyngeal space, or this may be accomplished by a slight
push with the button of Belloc's canula, or any other insignifi-
cant force. From here it generally passes into the mouth
without any assistance, and is spit out. At the most we may
have to move the velum a little with the finger, in order to
assist in this descent, or even in this way to draw the tampon
down out of the naso-pharyngeal space. There are cases, how-
ever, in which the tampon seems to be wedged into the posterior
nares, and in which, without the thread above referred to, there
would be difficulty in removing it ; hence it is not an unworthy
precaution to add the thread that comes out at the mouth. If
the latter is not employed, it is well enough to keep a finger in
the pharynx during the removal of the tampon, so as to prevent

it from being swallowed, unless one can place entire reliance on the patient in this matter.

We have thus far indicated the means of relief which we consider of value against nosebleed, as such, during the attack. We may add that the occurrence of fainting during the flow is worthy of special attention, for the sake of preventing the entrance of blood into the trachéa. In patients who are sitting up, the head should be inclined as far forward as possible, and in those lying down we may place them with the vertex dependent, as is proposed by Rose for operations " on the hanging head." The determination of blood to the brain, thus produced, can under the circumstances only be desirable. In the severe nosebleed of unconscious persons, plugging the posterior nares is to be carried out as soon as possible, to avoid the flow of blood into the pharynx, etc. Aside from this, fainting, as well as acute or chronic anæmia, is to be combated by the means ordinarily employed in these conditions.

In appropriate cases, *transfusion* may also be indicated in epistaxis. According to Mosler,' in one case of leukæmic nosebleed, not only the attack, but also the return of epistaxis, as well as of any other hemorrhages, was prevented—in other words, the hemorrhagic diathesis was cured—by this means. We believe that, in view of the existing experience in transfusion, it should not be put off too long. If serious evidences of acute or chronic anæmia appear, transfusion is a means which not only removes this condition, but also seems essentially to aid in the arrest of hemorrhage (by exciting the tonicity of the vessels ?).

We have purposely, thus far, avoided any reference to the *internal use of hæmostatics*, because we have been dealing with the therapeutics of the attack of hemorrhage itself, and the effect of internal remedies is obtained so late that the most which could be expected of them is to serve as adjuvants to the means already described. But, on the other hand, these drugs serve a good purpose in *preventing the recurrence of hemorrhage*. Ergot ranks highest in this category, whether it be in habitual nosebleed or in that dependent on a hemorrhagic diathesis or on

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1 Leukaemie, S. 267.

infectious diseases, and it may be best employed in the form of the extract, whether given internally or by hypodermic injection. A solution of chloride of iron, tannin, acetate of lead, sulphuric acid, and other styptics may also be ordered.

As a matter of course, individual causal indications will have to be duly regarded in our therapeutics. Traumatic injuries, for example, will demand the application of cold; diseases of the nose will call for their own appropriate treatment. The habitual nosebleed of anæmic persons requires supporting treatment (quinine and iron). Vicarious epistaxis, or that accompanied with fluxionary manifestations, may be benefited by the use of an unirritating scanty diet, dilute sulphuric acid, and determination to the bowels (by the use of Friedrichshaller bitter water, etc.) In such cases, too, *prophylactic abstraction of blood* may be employed, the amount of which can be controlled (venesection, wet cups, leeches to the anus, scarification of the uterus). But they do not always prevent the occurrence of the hemorrhage that is feared. I know a girl who suffers from amenorrhœa, from a high degree of general plethora, and from frequent epistaxis, who, for that very reason, voluntarily offered herself as the blood-giver in a transfusion, and who suffered from spontaneous nosebleed during the operation, while the blood was being copiously withdrawn from her radial artery. These prophylactic abstractions of blood should be confined to full-blooded individuals.

TUMORS OF THE NASAL CAVITY.

Tumors of the nasal cavity are generally grouped together under the head of nasal polypi. If the designation "polypus" is appropriate anywhere it is here, for the term was originally used with reference to tumors within the nose, especially those that were pedunculated. The resemblance to the animal of the same name may have been found in the method of their attachment or in the appearance of the flesh.

The matters falling under this head belong chiefly within the

domain of surgery, and we shall therefore confine ourselves to the following remarks :

The so-called *mucous polypi* are of most frequent occurrence within the nose. These tumors, whose structure has been more particularly described by Billroth,[1] retain the elements of the mucous membrane from which they arise, and the epithelium of which still covers them ; the only difference lies in the fact that sometimes the glandular element and sometimes the connective tissue predominates. Generally, however, they consist of newly formed hypertrophic glands, which are held together by soft—frequently œdematous—connective tissue. In this case they deserve the name of adenomata. More rarely forms occur, which, according to their anatomical structure, must be designated as œdematous fibromata, or as sarcomata.

Mucous polypi occur at every age, but more especially between the period of puberty and about the age of forty. They are generally developed on tissue which is the seat of a chronic catarrh, and sometimes the fact that they spring from just the narrowest part of the nasal cavity (in acute bending of the septum, particularly at the opposite point of the mucous membrane) especially indicates their irritative origin. They are either pedunculated or attached by a broad base. They are sometimes solitary, being then generally located in the upper and anterior portion of the nose, and sometimes multiple, occupying one or both nasal fossæ, and even the adjoining cavities. They vary very much in size, from the small excrescences, like condylomata, which are found particularly in the region of the posterior nares, to those extensive tumors which may project from the nostrils, or extend through the posterior nares into the pharynx. They may close the openings of adjoining cavities, or the lachrymal canal, causing epiphora, and in rare instances may lead to distortions of the bony walls of the nasal cavities. Mucous polypi give rise to spontaneous hemorrhage less frequently than any other variety. They do not extend to other tissues than the one first involved, and belong exclusively to the class of benign tumors.

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[1] Ueber den Bau der Schleimpolypen. Berlin, 1855.

Mucous polypi arise and run their course without pain. Patients do not usually observe the presence of a polypus in the nose until its growth is so far advanced as to begin to produce stenosis of the nasal cavity. Sometimes their attention is not attracted to the formation of a tumor within the nose until the polypus begins to be visible from without. Up to that time they rest easy in the belief that they are merely suffering from nasal catarrh.

The diagnosis of polypi is made by palpation, but more particularly by inspection. A tumor is observed which in general looks like the mucous membrane itself, though usually somewhat paler and more transparent. The latter is especially the case in pedunculated tumors. Those polypi which are attached by a broad base often look so much like the surrounding mucous membrane that it is scarcely possible to tell with the naked eye whether one is dealing with a new-formation or merely with hypertrophied mucous membrane. If a polypus is pedunculated, and its club-shaped extremity is not wedged in, it may be moved back and forth by the respiratory current. In such cases, therefore, a polypus seated at the back of the nose may often be brought into view by causing the patient to make a forcible expiratory effort, especially through the affected nostril.

Whereas follicular cysts are seldom encountered in the Schneiderian mucous membrane, they do sometimes occur in mucous polypi, and especially in those of the antrum of Highmore. In this locality they are multiple, and may grow so large as finally to fill the entire cavity and even to begin distending its walls. Virchow [1] considers it probable that the condition usually denominated *hydrops antri* is due, not to a free dropsy in the antrum, but to this kind of polypus, the walls of which, filling the entire cavity, might easily be overlooked.

Neoplasms similar to mucous polypi are found in the vicinity of the nostrils; their outer surface, however, more nearly resembling the skin, being covered with epidermis instead of mucous membrane epithelium.

Sarcomatous and fibromatous tumors of the nasal cavity,

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[1] Geschwülste, I., S. 245.

generally taking their origin from the periosteum, rank next in frequency to mucous polypi. They may also grow into the nasal cavity from all the adjoining cavities (naso-pharyngeal polypus, tumor retromaxillaris), and through all the canals opening into it, just as, on the other hand, nasal polypi may extend outward through all these openings from the nasal cavity. They are distinguished from mucous polypi by their firmer and harder structure. They spread beyond the tissue in which they originate, destroying the neighboring parts, and therefore, as a rule, belong to the malignant tumors. They are furthermore particularly dangerous by reason of their disposition to penetrate into the cavity of the cranium.

These tumors lead to hemorrhage much oftener than the mucous polypi, and they not infrequently present a teleangiectatic structure. In the case of polypi originating in the posterior portion of the nasal cavity, Virchow[1] leaves it undecided whether any rôle is played by the growth of the erectile tissue here found (compare page 123), although he considers it probable that these tumors also are teleangiectatic fibromata and not true angiomata.

Aside from this, the nose and contiguous cavities may be the seat of tumors of different varieties: chondroma and osteoma, myxoma, epithelial carcinoma, and carcinoma—tumors which we leave altogether to be considered in works on general surgery. In the same way we shall only refer to the presence of ecchinococci, which are of rare occurrence. We must not, however, fail to refer to the possibility of nasal polypi being simulated by *hernia of the brain*, making it necessary to be on one's guard against this chance of error in case of congenital tumors. The diagnosis is determined by the presence of a bony canal and the possibility of a partial or complete replacement, which is usually of easy demonstration.

As regards the symptoms of tumors of the nasal cavity, we may refer to what was said above under the head of stenosis and chronic coryza. The necessary points for diagnosis have also been given under the head of general considerations.

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[1] Geschwülste, III., S. 463.

The therapeutics of these tumors belongs in the domain of general surgery, as it is a question of their removal by torsion, cutting, crushing, burning, etc. The attempt to remove polypi by caustics is only practicable where they are small. In order to prevent relapses we must endeavor, by the methods indicated above, to cure the chronic rhinitis which usually exists as a complication.

On the subject of glanders, lupus, and syphilis, the reader is referred to the appropriate chapters of this Cyclopædia.

FOREIGN BODIES AND CONCRETIONS.

The foreign bodies found in the nose may *originate within the organism* of the person in whom they are found, having their source, 1st, within the nose and its neighboring cavities, or, 2d, elsewhere in the body, and being carried thither. Thus, for instance, carious bones of the nose may become detached, leave their original site, and serve as foreign bodies in some other part of the nasal cavity. In the same way secretions, pseudomembranes, etc., may be loosened from their point of development, and become foreign bodies elsewhere. The substances falling under the second class may comprise portions of the respiratory or digestive organs which are driven through the posterior nares in the act of coughing, or more commonly, in retching or vomiting. If such a state of things is encountered in the dead body we must first inquire whether it was produced during life or after death, due, perhaps, to awkwardness in transporting the body. In the latter case the contents of the stomach, if present, may be recognized by their acidity and the presence of the sarcina ventriculi. But it is hardly possible to exhaust the list of substances which may find their way into the nose from other parts of the body. The attention of physicians has been specially directed to the occasional presence of the ascaris lumbricoides, or round worm, within this cavity. Fr. Thiedemann[1] has col-

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[1] Von lebenden Würmern und Insekten in den Geruchsorganen des Menschen. Mannheim, 1844, p. 7.

lected a list of cases in which lumbrici, which had left their usual habitat and crawled into the stomach, were discharged by the nose instead of the mouth, or even remained for a considerable time within the nose or its contiguous cavities, sometimes causing very serious disturbances.

Foreign bodies not originating within the organism may enter the nose, first, through the nostrils ; second, through the posterior nares ; or third, through the integument of the face, in cases of wounding of the latter. . Of course they most commonly enter through the nostrils, especially if we include in the category of foreign bodies the particles of dust floating in the air and the substances that are snuffed up the nose as remedies for coryza or by snuff-takers. Some children and insane people have a fancy for putting all sorts of things up their noses, besides which some articles may get into the nose by accident. Much more rarely such foreign bodies may enter the nose through the posterior nares. Thus Lowndes [1] removed a ring from the posterior nasal aperture of a child fifteen months old. The size of the ring was too large to have admitted of its introduction through the nostril ; it must have been swallowed, and have passed into the nose from the pharynx. When there is paralysis of some of the muscles of deglutition, the escape from the pharynx into the nose of articles that should have been swallowed is more frequent. Among the foreign bodies that enter the nose through the skin may be mentioned broken knife-blades, [2] spent bullets, or other hard substances that are driven against the face with a certain degree of violence, and, entering the nasal cavity, may sometimes remain there a long time without producing any serious symptoms. [3]

It is manifestly impossible to enumerate all the foreign bodies that may thus be introduced into the nose, for anything that can be forced through the nostrils may at some time be passed into the nasal cavity by a child. Glass beads, peas, and beans seem to be used for this purpose oftener than anything else, and we must not forget that the latter sometimes germinate

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[1] Brit. Med. Journ., 1867, Sept., p. 206.

[2] *Rodolfi*, Gurlt's Jahresb. d. Chirurg. für 1863–65.

[3] *Cloquet*, Ophresiologie. Uebers. Weimar, 1824, p. 405.

within the nose, and produce quite considerable roots and sprouts.[1] Among the materials claiming attention are all the minute particles that pass into the nose with the air inspired, such as soot and dust, with all the organic and other matters accompanying it, as well as the floating pollen of plants and grasses which have been mentioned above as well as in the second part of this work, as the probable cause of hay fever.

The manifestations produced by foreign bodies within the nose vary greatly, according to their nature and amount, as well as the duration of their stay. The idiosyncrasies of the indi-vidual attacked, however, also exert an important influence. Thus the susceptibility to hay fever is almost exclusively con-fined to persons of the more cultivated class. A still more familiar instance of the same thing is found in the very different degrees of irritation produced by snuff on the nasal mucous membrane of different persons. In some every pinch of snuff produces spasmodic sneezing. Canstatt[2] even declares that a single pinch gives him a severe cold in the head, while others can use even the strongest varieties of snuff in large quantities without causing any reaction of the Schneiderian membrane. Here, of course, habit plays an important rôle, as well as predis-position, and just as snuff-takers become accustomed to tobacco, many artisans become tolerant of irritants which come in con-tact with their nasal mucous membranes incidentally to their daily employments. It may, however, be announced as a gen-eral rule, that the immediate effect of foreign bodies within the nose is to produce circumscribed inflammation. Still they do sometimes remain in the nasal cavity a long time without caus-ing any trouble whatever. Generally, however, if they are not soon expelled by sneezing or by artificial means, they eventually give rise to chronic rhinitis, ordinarily accompanied by ulcera-tion and ozæna, so that a bloody, purulent, and often fetid secretion is added to the other symptoms of the presence of a foreign body within the nose. If such bodies are at all volu-

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[1] *Cloquet*, l. c., p. 414. *Duchek*, l. c., p. 458. *Th. Smith*, Brit. Med. Journ., 1867, II., p. 547.

[2] Handbuch der med. Klinik, II. Aufl. Berlin, 1840, III., 2, p. 7.

minous, they of themselves cause stenosis of the nasal cavity on the side implicated, frequently accompanied by severe headache, which may be either local or radiate over the entire head. These pains are especially liable to be present when the body is lodged in one of the neighboring cavities. From time to time the symptoms become aggravated, even if no changes take place in the body itself of a nature to cause fresh irritation, as for instance when beans germinate. Cases are also reported in which severe brain symptoms have disappeared immediately after the removal of foreign bodies from the nose.

Great importance attaches itself to objects introduced into the nose when they become the nucleus for the formation of *concretions*. Rhinoliths[1] are not of very frequent occurrence, but most of them are found to contain some body not belonging to the organism, around which the calcareous deposit has taken place. It is very unusual to find nasal calculi developed only around retained secretions. Rhinoliths may attain a very considerable size. Verneuil[2] encountered one of such proportions that he was obliged to reduce it by lithotripsy before it could be extracted. Brown[3] extracted one measuring an inch and three-quarters in length, an inch in width, and half an inch in thickness. Calculi may be formed in any part of the nasal cavity, but are most frequent in the inferior meatus. They are of variable consistency, and usually consist chiefly of phosphate and carbonate of lime.

The formation of calculi is not to be confounded with *calcareous degeneration of the mucous membrane* itself, which is sometimes found within the nose, usually of old, but occasionally of young persons, in consequence of what is known as the ossific diathesis. The mucous membrane of the cavities contiguous to the nose, particularly those of the sphenoid bone, are especially liable to this change ; but the membrane covering the turbinated bones, too, may be thus affected, developing first fine, granular points, and afterwards plates of calcareous matter, and

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[1] *Demarquay*, Rhinolithie, Arch. gén. de Méd., 1845, Juin.

[2] Gaz. des Hôpit., 1859, p. 152.

[3] Edin. Med. Jour., Dec., 1859, No. LIV., p. 501.

assuming a corresponding change in appearance, that is, an almost white color.[1]

The *diagnosis* of a foreign body is always easy, if, in obtaining the history of the case, the introduction of such a body is reported. But the patients or their attendants often know nothing of the occurrence, and the way in which a foreign body was introduced is often explained only after its extraction. It is therefore well not to lose sight of this possibility in all cases of chronic rhinitis, or of the manifestations described above. The demonstration of foreign bodies takes place by means of palpation and inspection. In palpation with the probe, the touching of stones, pieces of metal, and the like, sometimes calls forth a characteristic sound.[2] The only thing which, by the touch, may be confounded with a foreign body is a denuded portion of bone. We must not here be misled, and suppose we are necessarily touching bone because the patient perceives the touch, for this likewise occurs on touching foreign bodies which lie in close contact with the mucous membrane, etc. As a rule, however, we shall obtain the necessary evidence for distinguishing between foreign bodies and bone by the mobility of the object, its site, the character of its surface, etc. As regards inspection, we must not forget that such bodies are usually covered with secretions, the removal of which is necessary before the body itself can be seen.

When we have satisfied ourselves of the presence of a foreign body, it should be removed as soon as possible. After its removal the accompaning disturbances are usually cured without any of our assistance. If not, however, they must be treated according to the methods already indicated in the appropriate sections of this work.

The *removal* of small bodies may be attempted by provoking the act of sneezing, through the use of snuff. In such cases, too, the employment of the nasal douche has sometimes been effective, the nozzle being, of course, introduced into the nostril of the sound side. If these methods fail, or if the size and posi-

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[1] *Virchow*, Cellularpathologie, IV. Aufl. Berlin, 1871, p. 453, and Note ††, as well as *Kölliker*, Gewebelehre, Geruchsorgan.

[2] *Köstlin*, Württemb. Corresp.-Bl., 7, 1854.

tion of the foreign body satisfy us, in advance, that they are useless, we must proceed to extraction. The procedures to be undertaken for this purpose belong to the domain of surgery ; we will therefore here only remark that extraction is accomplished most readily by means of spoon-shaped or fenestrated instruments, and that if the object lies very far back we may endeavor to push it into the pharynx and extract it thence, at the same time carefully guarding the mouth of the larynx.

PARASITES OF THE NASAL CAVITY.

Among the *vegetable parasites* reference has been made by some writers to the occurrence of Oïdium albicans within the nose. This, however, is very rare, the Schneiderian membrane, like all mucous membranes lined with ciliated epithelium, being but seldom infected with this growth.

Among the *infusoria* different varieties of Cercomonas may be found within the nasal cavity.

As regards the *living creatures*[1] which are encountered within the nose, they must be regarded as pseudo-parasites. For there are no true parasites of the human nasal cavity, that is, no animals destined to find their nourishment and spend a certain period of their lives there. The entrance of living creatures into the nose is always more or less a matter of chance. This is particularly true with regard to those animals that naturally shun the light and are fond of living in dark holes, and which sometimes crawl into people's noses, no doubt during their sleep. Thus we have trustworthy observations[2] confirming the existence within the nose of centipedes (Scolopendræ), ear-wigs (Forficula auricularia), as well as the larvæ of the bacon-beetle (Dermestes lardarius). Centipedes are particularly liable to be found in the frontal sinuses, where they may remain for

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[1] Compare *Fr. Thiedemann*, Von lebenden Würmern und Insekten in den Geruchs-organen des Menschen. Mannheim, 1844.

[2] *Thiedemann*, l. c., p. 11 et seq.

years, the secretions of these cavities furnishing them with sufficient nourishment. The entrance of leeches, worms, or insects into the nose is even more purely accidental than that of the creatures mentioned above. The occasional entrance of round or lumbricoid worms has already been alluded to.

The most interesting fact in connection with this question, and one which has been established by the most numerous observations, is the occurrence, within the nasal cavity, of the larvæ of dipterous insects. These may be considered under three heads: 1st. Attracted by the perfume emanating from an ozæna, *flies* (Musca vomitoria and Musca carnaria) deposit their eggs in the vicinity of the nostrils, and these eggs when hatched are nourished by decomposing organic matters. This is especially easy in the case of persons sleeping in the open air during the day. Thus, now and then, we may find maggots present in a case of ozæna as on any other fetid purulent surface on the body. This occurs more frequently in the tropics, but may also happen with us.[1] 2dly. In the tropics, especially in Cayenne and Mexico, there is a fly (Lucilia hominivora) which sometimes forces its way even into healthy noses, and lays its eggs there, whereupon the larvæ, measuring about half an inch in length, are developed there at the end of fourteen days.[2] Now and then the larvæ of the gad-fly (Oestrus), which are more frequent in the noses of sheep and cattle, may be found in the human nasal cavity. But in these cases the determination of the variety has not been carefully made. In a matter of such importance we should never fail to have any living creatures that are found within the nasal cavity accurately classified by a thorough zoologist.

The *symptoms* which are caused by living animals in the nose vary according to the number, the size, and the variety of the pseudo-parasite. The variety determines the length of time they may remain in the nose, and this has a great influence on the

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[1] Compare *A. von Frantzius*, Virchow's Archiv, 43, p. 98, and *Mankiewicz*, ibid., 44, p. 375.

[2] *Weber*, Recherches sur la mouche anthrophage du Méxique. Rec. de mém. de méd. mil., 1867, Fevr., p. 158; Jahresber., 1867, I., p. 312.

course of the symptoms. Centipedes may, as already intimated, remain in the nose for years, while maggots do not grow more than two weeks old before they leave the nose for the purpose of forming their cocoons. Almost without exception, however, parasites within the nose cause the most serious symptoms. They generally occasion violent pain, especially in the head, in the forehead, or in the region of the cheek. This may be bilateral or confined to the side on which the animal is located. The pain may be so violent as to drive the patient to despair, and soldiers of the French army in Mexico have been known to commit suicide because they could no longer endure the suffering caused by dipterous larvæ within the nose.[1] Sleeplessness, delirium, unconsciousness, dizziness, and psychical disturbances are likewise among the symptoms, as well as radiating pains along the course of the trigeminus, sneezing, vomiting, and reflex spasmodic manifestations. Sometimes patients have a distinct feeling of the voluntary movements of some foreign body within the nose.

Next in order follow the *evidences of inflammation*, which are both local and general, accompanied with fever. Inflammatory action is especially pronounced when the larvæ of flies are present, and we are then, as in cases of blennorrhœa, very likely to find œdematous swelling of the face, and sometimes of the velum palati, the latter interfering with deglutition. During the limited duration of the life of maggots within the nose, therefore, a well-marked group of symptoms arises, which, according to Labory, is designated in Hindostan by the name of Peenash.[2] The name is said to come from the Sanscrit, and to indicate all diseases of the nose, but von Frantzius reminds us of its resemblance to Punaisie.

The presence of parasites within the nasal cavity does not always increase its *secretions*. There is usually, however, a sero- or puro-sanguinolent discharge. Frantzius calls attention to the fact that the discharge changes in character on the emigration of maggots from the nose. As long as they remain within

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[1] *Weber*, l. c.
[2] Compare *Hirsch*, Hist. geogr. Pathol. Erlangen, 1862–64, II., p. 19.

its cavity the discharge is sero-sanguinolent and less fetid than afterwards. After their emigration it is purely purulent.

The *prognosis*, in cases of parasites within the nose, cannot always be favorable. Fatal results, for instance, have followed the harboring of maggots within this cavity.

The *diagnosis* of the affection depends on the demonstration of the living creatures within the nasal cavity. As has already been stated, the symptoms produced by the presence of maggots are sufficiently characteristic to induce us to look for them, even aside from any evidence that may be furnished by the patient. Maggots are readily recognized by the eye, on account of their incessant movements. As regards the other animals alluded to, our diagnosis is usually not established until they are brought away, or are found present at the autopsy.

Therapeutic interference should be directed to the removal of the parasites. We must here guard against false therapeutic conclusions, as the spontaneous discharge or the physiological migration of the intruders, as in the case of the larvæ of flies, may easily be accredited to some remedy employed. Where it is possible, we should take pains to seize the animals and extract them. Frantzius calls attention to the fact that the habit which maggots have of clinging in groups greatly facilitates their extraction, because on seizing them with the forceps one usually brings away not one, but a number. The other animals with which we have to deal here are usually so hidden that no direct attempts at their removal are to be thought of. It is worthy of mention, however, that according to Morgagni,[1] the surgeon Cæsar Magatus, in Bologna, opened the frontal sinus and removed a worm from there. If the animals cannot be seized, the attempt should be made to secure their expulsion by means of sneezing, and finally, means are to be used for killing them. For this purpose we may employ the inhalation of alcohol, ether, turpentine, or, as Weber proposes, of chloroform, or the injection of a solution of corrosive sublimate, of decoctions of bitter herbs or tobacco, or of turpentine. Frantzius recommends the use of calomel in powder, which should be blown into the

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[1] De sedibus I. 9, Advers. anat. VI., animadv. 90.

nose. Mankiewicz has seen good results follow pencillings with balsam of Peru. The remaining symptoms should be treated according to the principles laid down in the previous chapters on ozæna and blennorrhœa.

The neuroses of the nasal cavity are treated of in the eleventh volume of this work.

THE

DISEASES OF THE LARYNX.

INTRODUCTION.

ANÆMIA, HYPERÆMIA, HEMORRHAGE, ABNORMAL COLOR,

AND THE

CATARRHAL INFLAMMATIONS OF THE LARYNGEAL MUCOUS MEMBRANE.

VON ZIEMSSEN.
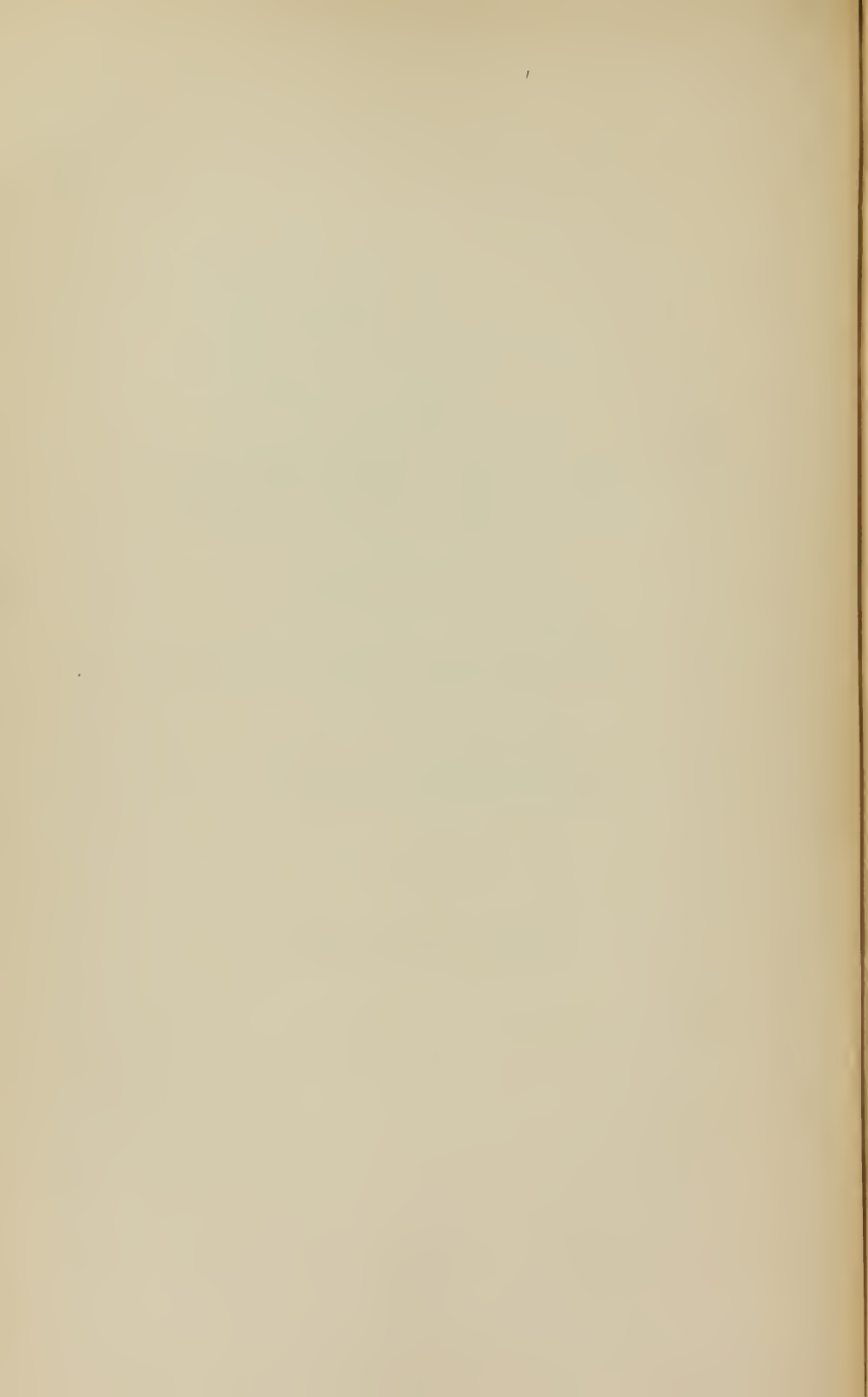
INTRODUCTION.

General Literature.

Cheyne, The Pathology of the Membrane of the Larynx, pp. Edinburgh, 1809.—*Porter*, Observations on the Surgical Pathology of the Larynx and Trachea. Dublin, 1826.—*Albers*, Die Pathologie und Therapie der Kehlkopfskrankheiten. Leipzig, 1829.—*Colombat*, Traité med.-chir. des maladies des organes de la voix. Paris, 1834.—*Ryland*, A Treatise on the Diseases and Injuries of the Larynx and Trachea. London, 1837.—*Trousseau* et *Belloc*, Traité pratique de la Phthisie laryngée, de la laryngite chron. et des maladies de la voix. Paris, 1837.—*H. Green*, Treatise on Diseases of the Air-Passages. New York, 1846.—*Hastings*, Treatise on Diseases of the Larynx and Trachea. London, 1850.—*Dufour*, Sur le diagnostic special et differentiel des maladies de la voix et du larynx. Paris, 1851.—*Friedreich*, Die Krankheiten des Larynx und der Trachea in Virchow's Handbuch der spec. Pathologie und Therapie, Bd. V. Erlangen, 1858.—*J. N. Czermak*, Der Kehlkopfspiegel und seine Verwerthung für Physiologie und Medicin. Leipzig, 1860.—*H. Rühle*, Die Kehlkopf-Krankheiten, klinisch bearbeitet. Berlin, Hirschwald, 1861.—*Moura-Bouroillou*, Traité de laryngoscopie. Paris, 1864.—*v. Bruns*, Die Laryngoskopie und die laryngoskopische Chirurgie. Mit Atlas. Tübingen, 1865.—*L. Türck*, Klinik der Krankheiten des Kehlkopfes und der Luftröhre, etc. Wien, 1866. Mit chromolith. Atlas. —*v. Ziemssen*, Laryngoskopisches und Laryngotherapeutisches, D. Archiv für klin. Medicin, Bd. IV., S. 221 und S. 376 ff, 1868.—*Morell-Mackenzie*, The Use of the Laryngoscope in Diseases of the Throat. London, 1865; third edit., 1871; Hoarseness, Loss of Voice, and Stridulous Breathing. Essays on Throat Diseases, No. I. London, 1868; sec. edit., 1870.—*E. Navratil*, Laryngologische Beiträge. Leipzig, 1871.—*Mandl*, Traité pratique des maladies du Larynx et du Pharynx. Paris, Baillière, 1872.—*Cohen*, Diseases of the Throat. New York, 1872.—*Tobold*, Laryngoscopie und Kehlkopfkrankheiten, Klinisches Lehrbuch, III. Aufl. Berlin, Hirschwald, 1874.—*L. Schrötter*, Laryngologische Mittheilungen, Jahresberichte der Klinik für Laryngoskopie an der Wiener Universität (pro 1870) 1871 und (pro 1871–1873) 1874.—*Heinze*, Laryngoskopisches, Archiv der Heilkunde XVI., Heft 1, 1875.—*Burow*, Laryngologische Mittheilungen, v. Langenbeck's Archiv für Chirurgie, XVIII., S. 228 ff., 1875.

See also the Hand-books of Special Pathology and Therapeutics, by *Canstatt*, Vol. III., *Wunderlich*, Vol. III., *Duchek*, Vol. I., as well as *L. Merkel's* Reports on

the Recent Progress in Laryngoscopy, Schmidt's Jahrbücher, Vol. 108, 1860; Vol. 113, 1862; Vol. 119, 1853; Vol. 133, 1867.

A full bibliography of the older literature (up to 1859) will be found in *Rühle's* work, above referred to, on Diseases of the Larynx.

HISTORY.

On careful examination the pathology and therapeutics of the larynx are found to present three periods of development.

The *first period* extends to the beginning of the present century; it displays a great meagreness of facts, and a lack of interest in the investigation of details. The darkness which prevailed in regard to the pathology of the larynx, or at least its anatomical changes, was illuminated only by a few rays of light from the genius of Morgagni.

The *second period* includes somewhat more than the first half of the present century, and is characterized by the awakening of a more lively interest in the promotion of the physiology and pathology of the larynx. Here are to be mentioned a series of fundamental investigations, to which we are indebted for an important advance in laryngeal science, such as those of Johannes Müller and Henle on the physiology and comparative anatomy of the larynx; of Cruveilhier, Rokitansky, and Rheiner on its pathological anatomy; and of Cheyne, Jurine, Albers, Ryland, Trousseau, and Belloc on its pathology and therapeutics.

The *third period* dates from the year 1858, and was inaugurated by the *introduction* of the *laryngoscope* into medicine by Türck and Czermack. The ocular inspection of the interior of the larynx disclosed so many new and unsuspected facts that it was necessary not only to fundamentally reform the whole of the pathology of the larynx, and part also of its physiology, but also to completely revolutionize its therapeutics. Such a rapid and brilliant progress as has taken place in laryngeal science within the past seventeen years has scarcely a parallel in the history of medicine. The nearest approach to it is the advance made in ophthalmology since the introduction of the opthalmoscope, and yet the improvements in diagnosis and

treatment effected by this instrument are scarcely as striking as those gained by the laryngoscope.

The literature of this period abounds in recorded observations to a degree that is almost oppressive, and each day brings fresh material, as might be expected from the fact that this new-born and fruitful science has attracted to itself the general interest of investigators. In Germany, especially, we see much of the best talent engaged in completing the construction of a science of laryngeal pathology and therapeutics. Moreover, the laryngoscope is beginning to be regarded and employed as an instrument indispensable in medical practice for the diagnosis and treatment of laryngeal diseases. That it has not yet come into general use among physicians is not to be wondered at, in view of the unusually great difficulties which the new art presents, and in view of the fact that it is only within the last few years that special attention has been devoted in the German universities to the theory and practice of laryngoscopy and laryngoscopical therapeutics. The general introduction of percussion and auscultation into medical practice, we should remember, required several decades at the beginning of this century. Our universities should see to it that particular attention is paid to this specialty, at least sufficient for the practical needs of the physician ; it is also especially the duty of clinical physicians to treat laryngoscopy as of equal importance with other methods of physical diagnosis, and to insist upon the indispensableness of the laryngoscope in the local treatment of laryngeal diseases.

The portion of laryngeal science which has been most advanced by the introduction of the laryngoscope, is that whic his really of the most importance, viz., the doctrine of acute and chronic catarrh, of ulcerative processes in the larynx, of laryngeal stenoses, and of neoplasms and neuroses. On the whole it is no exaggeration to say that at the present time there is scarcely any department of medical science of which the physiology and pathology are so well understood, or the results of treatment so gratifying as is the case with the larynx.

A word more in regard to the exposition and division of our subject may not be out of place.

In view of the fact that the modern methods of physical examination of the upper air-passages, and the methods of local treatment based thereon, have not yet become naturalized in medical practice to such an extent as to be generally well known, and their importance sufficiently appreciated, we have determined, in the consideration of these organs, to depart from the usual method, and to devote a separate chapter to their physical diagnosis and general therapeutics; a plan which we have no doubt will commend itself to the approval of the reader. A strict adherence to logical order is, in our opinion, inappropriate in a work which is designed to give a clear picture of the incessant commotion of clinical science. If the picture is to be drawn correctly, those questions, with which the scientific industry of the time is especially busied, should receive particular attention, and should be assigned a prominent position corresponding to their scientific and practical importance.

DISEASES OF THE MUCOUS MEMBRANE OF THE LARYNX.

ANÆMIA, HYPERÆMIA, HEMORRHAGE, AND ABNORMAL COLOR OF THE LARYNGEAL MUCOUS MEMBRANE.

Anæmia.

Etiology and Symptomatology.—In chlorosis, and after loss of blood, typhus, and other severe diseases, the mucous membrane of the larynx naturally takes part in the general anæmia. But besides this, a purely local anæmia, which it is difficult to explain, may occur at the outset of pulmonary consumption, and, as Tobold[1] and myself have noticed, in perfectly healthy individuals of ruddy appearance, especially females. The nervous symptoms, pain in the larynx, tickling, inclination to cough, convulsive cough, and sensitiveness to changes of temperature, which generally accompany this local anæmia of the larynx, are regarded by Tobold as due to the same cause as the anæmia, viz., a local derangement of nutrition. My own observations have convinced me, however, that the neurotic-hysterical disturbance occurs first, and that upon these anomalies of sensibility—hyperæsthesia, paræsthesia, and anæsthesia—there supervene vaso-motor derangements, which may manifest themselves in the form of vascular spasm and ischæmia (see *infra* the article on Derangements of Sensibility).

The epiglottis never presents the high degree of anæmia which is seen in the rest of the laryngeal mucous membrane.

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[1] Lehrbuch, S. 141.

Hyperæmia.

Etiology.—Fluxionary hyperæmia occurs either in a diffuse, or in a partial form, and generally as a result of mechanical irritation of the laryngeal mucous membrane ; as for instance from long-continued loud speaking or singing, but in a higher degree from foreign bodies, such as particles of food, sand, or hard, sharp bodies, which have entered the orifice of the larynx. When acrid or sharp foreign substances of small size become impacted in these parts, as for instance in the ventriculus Morgagni, and are not quickly removed, the hyperæmia increases rapidly to the highest degrees of inflammation with copious infiltration of the mucous and submucous tissues (see the section on Foreign Bodies and Œdema of the Larynx). Hyperæmia may also be produced by chemical and thermal influences (acrid vapors, hot drinks, etc.).

Passive hyperæmia of an acute character may be produced by severe paroxysms of coughing, for example in pertussis, and in such cases may even lead to the rupture of blood-vessels. Chronic venous hyperæmia is met with in valvular affections of the heart as a result of congestion in the general venous circulation ; also in emphysema of the lungs, etc.

The *anatomical changes* are shown tolerably well by the laryngoscope. The injection of the mucous membrane varies with the intensity, quality, and duration of the irritation, and may be moderate or severe, diffuse or partial. The favorite situations for partial hyperæmias are the vocal processes, the capitula of Santorini, and the inter-arytenoid region. In passive hyperæmia the color is rather livid, and the veins, especially on the epiglottis, are considerably dilated.

Hyperæmia passes imperceptibly into catarrhal inflammation, and it is impossible to draw a sharp anatomical or clinical distinction between the two conditions.

Besides the lesions revealed by the laryngoscope, the symptoms of hyperæmia consist of more or less hoarseness, dryness, and slight pricking pains in the larynx. If the irritation cease, and proper rest be given to the part, these symptoms may disappear after a few hours, with the secretion of a little mucus ;

but if the irritation be frequently repeated, and rest be disregarded, all the signs of laryngeal catarrh are developed.

Hemorrhage of the Mucous Membrane of the Larynx.

Etiology.—Hemorrhages upon the free surface of the mucous membrane naturally occur most readily from solutions of continuity ; also from wounds and contusions of the larynx, and from ulcerations of the mucous membrane.   In the absence of such lesions a capillary hemorrhage may be induced by a very active inflammation,—such cases have been described by Semeleder,[1] Navratil,[2] Tobold,[3] Fraenkel,[4] and Mandl,[5]—or rupture of the vessels may be produced by an intense venous stasis, as not infrequently happens in whooping-cough.

Symptoms and Course.—The laryngeal hemorrhages, which are not of traumatic origin, are generally unimportant.   The blood extravasated into the tissue of the mucous membrane and upon its surface is slight in amount ; it generally appears only in the form of streaks upon the catarrhal secretion, and soon disappears.   In most cases the laryngoscope reveals only a small bleeding point.

In Navratil's case, the vocal cord was covered with a dark-brown layer of blood, which re-formed several times after being wiped off. The mucous membrane underneath was swollen and injected.

Similar to this—only more extensive, and present also in the trachea—was the hemorrhage in the case of laryngitis hemorrhagica reported by B. Fraenkel. Here also the amount of blood was small, the color dark-brownish, almost blackish, and the consistence that of a viscous crust.   Previous to the hemorrhage the patient had suffered from catarrhal laryngitis, and this had become much worse in consequence of the very stormy weather and the frequent vomiting due to pregnancy.

Tobold also reports two cases of hemorrhage from catarrhal laryngitis ; in one instance the blood came from the border of the epiglottis, in the other from the right vocal cord.

Mandl observed a hemorrhage from one of the ventricles of Morgagni.

[1] Laryngoskopie, 1863.

[2] Laryngologische Beiträge.   Leipzig, 1871, S. 18.

[3] Lehrbuch, S. 143.

[4] Berliner klinische Wochenschrift, 1874, No. 2.

[5] Maladies du larynx, p. 644.

Severe hemorrhage has hitherto been observed only in rare cases.

Türck [1] describes a case of laryngeal syphilis in which fatal hemorrhage occurred from an eroded lingual artery, in consequence of an ulceration of the right sinus pyriformis with denudation and necrosis of the great cornu of the hyoid bone.

onsiderable hemorrhages into the submucous connective tissue—if we except those cases where the larynx has been wounded by cuts, stabs, shot, etc., as inappropriate to our subject—are just as rare as severe hemorrhages upon the surface of the mucous membrane. Cases of this nature are described by Bogros [2] and Pfeufer. [3]

In Bogros' case symptoms of œdema of the larynx suddenly occurred in a patient, twenty-two years of age, ill with variola hæmorrhagica. The autopsy revealed infiltration of the ary-epiglottidean folds from blood, and not from œdema.

In Pfeufer's case, the patient, forty-five years of age, who had incurred mercurial stomatitis from using inunction with mercurial ointment as a parasiticide, became ill with cough and symptoms of laryngeal stenosis, as was supposed from exposure to cold, and five hours afterwards died from suffocation. The autopsy showed a submucous extravasation of blood beneath the right ventricle of Morgagni, from one to three lines in thickness and a square inch in extent, and at the corresponding part on the left side a superficial extravasation.

Hemorrhagic infiltrations of this kind have, according to Ruehle, [4] been observed also in scorbutic conditions.

According to these observations, *the symptoms* of hemorrhagic infiltration of the submucous connective tissue are those of urgent laryngeal œdema, from which they are probably to be distinguished with certainty only by means of laryngoscopical examination ; although, of course, the antecedent existence of a blood-disease will make it more probable that the case is one of hemorrhagic submucous infiltration rather than œdema of the larynx.

The symptoms of hemorrhage from an acutely inflamed or

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[1] Klinik der Kehlkopfkrankheiten, S. 402.

[2] In *Sestier*, Traité de l'angine laryngée œdémateuse.   Paris, 1852, pp. 63 and 114.

[3] Henle and Pfeufer's Zeitschrift für rat. Medicin, Neue Folge., Bd. III.

[4] Kehlkopfkrankheiten, S. 172.

ulcerating mucous membrane are, on the other hand, usually very unimportant, and are limited to the occurrence of streaks of blood in the expectoration, and the lesions discovered by the laryngoscope. Still, the case of B. Fraenkel, referred to above, shows that even with superficial hemorrhage of the mucous membrane quite alarming attacks of stenosis of the glottis may occur, and may disappear upon expectoration of solid coagula of blood.

The *prognosis*, like the diagnosis, depends essentially upon the intensity and duration of the stenosis, as well as upon the laryngoscopical condition.

In the trifling hemorrhages which occur in laryngitis and ulcerations, the treatment may be limited to the local use of styptics (alum, liquor ferri perchloridi, etc., and, if necessary, the external and internal application of ice), measures which are generally found to be sufficient, while in hemorrhagic infiltrations of the submucous tissue experience has shown that tracheotomy is the main reliance as soon as symptoms of stenosis of the glottis manifest themselves (see *infra* the sections on Laryngitis Hæmorrhagica and Œdema Laryngis).

Abnormal Color of the Mucous Membrane.

Two varieties only will be here considered :

1. *Cyanosis* of the mucous membrane of the larynx, with a general bluish lustre, and development of numerous varicosities, a condition which was first recognized by Gerhardt in emphysema of the lungs, and which I have seen in an exquisite degree in patients with congenital cyanosis.

2. *Icterus* of the mucous membrane of the larynx. I have repeatedly seen this even in moderate jaundice, and to a very marked degree where the jaundice has been intense. The white color of the vocal cords enables us to estimate the amount of icteric color, just as in the case of the sclerotic, but the observation, to be satisfactory, must be made by sunlight, because in artificial light even a high degree of yellow color may be entirely overlooked.

INFLAMMATIONS OF THE MUCOUS MEMBRANE OF THE LARYNX.

Brétonneau, Des inflammations speciales du tissu muquex.   Paris, 1826.—*Guersant,*
Dictionnaire des sciences médicales, Art. "Croup."—*Piedvache,* Revue de The-
rapeut. medic.-chirurg., 1857, Nos. 6–8.—*Kerli,* Deutsche Klinik, 1858, Nos.
5–7.—*Gilewski,* Wiener med. Wochenschrift, 1861, Nos. 39 u. 40.—*Lewin,* Vir-
chow's Archiv, Bd. 24, S. 429, 1862.—*Hyde Salter,* Brit. Med. Journ., Sept. 13,
1862.—*Rühle,* Kehlkopfkrankheiten, S. 41 ff.—*Türck,* Klinik der Kehlkopf-
krankheiten, 1866, S. 145.—*Gerhardt,* Kinderkrankheiten, 11. Aufl., S. 257, und
Würzburger med. Zeitung, 1862, S. 10.—*Sherwood,* Acute Laryngitis, treated
by Nitrate of Silver Injections into the Larynx and Trachea, New York Med.
Journal, June, 1868.—*Cordes,* Die Recidive der chron. Laryngotracheitis,
Berliner klinische Wochenschrift, 1870, 2, S. 19.—*M. Mackenzie,* On the Differ-
ential Diagnosis of Chronic Inflammations of the Larynx, Lancet, 1872, Jan.
6.—*Lefferts,* A New Instrument for the Insufflation of Powders into the Larynx.
Med. Record, Nov. 15, 1873.—*Burow,* Laryngologische Mittheilungen, v. Lan-
genbeck's Archiv für Chirurgie XVIII., 228 ff., 1875.—*Robinson,* A Case of
Chronic Laryngitis, American Journal of the Medical Sciences, October, 1875.
The bibliography of croup is prefixed to the article on that disease.

LARYNGITIS CATARRHALIS ACUTA.   ACUTE CATARRH OF THE LARYNX.

Etiology.

The causes of acute catarrh of the larynx are very numerous,
but none of them is so frequently effective as catching cold.[1]
This is particularly the case in persons who are predisposed to
catarrhal inflammations of the air-passages, and especially of the
larynx.   Such a predisposition is, of course, most apt to exist

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[1] In regard to the nature of the process "catching cold," see the explanation by
Seitz, in his article On Certain Slight Disorders Occasioned by Catching Cold, in a
later volume of this Cyclopædia.

in persons who have had frequent attacks of laryngitis, and whose laryngeal mucous membrane has consequently become a *locus minoris resistentiæ.* In sensitive individuals this irritability of the mucous membrane frequently dates from the earliest youth, and owes its origin to an attack of croup, or whooping-cough, or to the remains of an obstinate scrofulous affection of the mucous membrane. The predisposition is increased by the habitual straining of the vocal organs, to which teachers, preachers, singers, and other professional persons are exposed; by delicacy of the skin, and a tendency to perspire; by wearing an excess of clothing so that the secretion of sweat is promoted; and especially by the habit, induced by professional ardor, of neglecting slight catarrhs. Frequently, however, no explanation can be given for the tendency to laryngeal and tracheo-bronchial catarrh. In many persons a primary catarrh of the nasal mucous membrane always extends to the throat, larynx, and trachea, while in most men it remains limited to the nose. The cold seems to originate sometimes in the skin immediately adjacent to the larynx, and at other times in distant parts of the skin. Thus, the laryngeal catarrh may be produced by leaving off a customary neckerchief, or by having the hair cut, as well as by getting the feet chilled and wet.

Catarrh may be excited also by all those injurious influences which have been mentioned as etiological factors of hyperæmia, when their action is more intense and longer continued, or when they attack a membrane already congested; such as mechanical irritations from prolonged loud speaking or singing, from foreign bodies—if they be not immediately removed; also from thermal influences, such as rude changes in the temperature of the respired air, too hot drinks, etc.; as well as from chemical substances, especially strong alcoholics, spices, particles of tobacco snuff which have passed into the larynx, and acrid gases and vapors, such as iodine, bromine, chlorine, etc. The certainty of laryngitis being produced by these deleterious agents is all the greater when several of them co-operate in their action upon an already predisposed laryngeal mucous membrane, as is the case with loquacious frequenters of public-houses, who carry their drinking, talking, and singing to excess, and after leaving the

heated room, filled with tobacco smoke, often expose themselves for a long time to the cold night air.

Certain *atmospheric influences* also undoubtedly produce catarrh. In the spring and autumn, catarrh of the larynx, as well as of the rest of the respiratory passages, not infrequently prevails *endemically*. In general, rude changes in the temperature and moisture of the air, as well as sudden shifting in the direction of the wind, are regarded as the most important causes. In the case of the catarrhal fever known as the *influenza* or *grippe*, which occurs epidemically, and implicates the laryngeal mucous membrane, it is necessary to assume the existence of a specific irritant or infective matter, although the intimate nature of this substance is still concealed from us (see article on Influenza, Vol. II., p. 515 et seq.). The laryngeal catarrh, which is developed in summer catarrh or *hay cold*, has been shown by the investigations of Blackley,[1] to depend solely upon the action of the pollen of certain flowering grasses and meadow herbs (see article on Hay Fever, in Vol. II., p. 539 et seq.).

Acute laryngitis very commonly occurs also in connection with many *infective diseases*, especially measles, and, less frequently, scarlatina, small-pox, and typhoid fever.

Finally, it may be also mentioned that the local treatment of the laryngeal mucous membrane with caustics or strong astringents, on account of small neoplasms, ulcerations, etc., sometimes excites a very active laryngitis, although, of course, in most persons the reaction to such treatment is inconsiderable, and disappears after a few days.

PATHOLOGY.

General Description of the Disease.

The general character of the disease varies extremely according to the severity and extent of the inflammatory process, as well as according to the age of the patient and the susceptibility of the larynx.

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[1] *Charles Blackley*, Experim. Researches on the Causes and Nature of Catarrhus æstivus (Hay Fever, Hay Asthma). London, 1873.

A. In the *mildest cases* the only symptoms are slight irritation and tickling in the larynx, a trifling impairment of the voice, increasing to hoarseness only when the voice is strained, and the secretion of a little tough mucus, which induces a frequent clearing of the throat. By this means the voice may, for a time, become clear again, but continuous talking is fatiguing. As there is no cough or constitutional disturbance, the patient is not prevented from attending to his business.

Inspection reveals a rosy injection of some portions of the mucous membrane, especially the posterior ends of the vocal cords, where they terminate in the vocal processes, the mucous membrane covering the inter-arytenoid region, the arytenoid cartilages and the ventricular bands.[1] The anterior parts of the vocal cords are either perfectly normal in appearance, or are stained of a faint rosy hue.

With proper care, especially in regard to sparing the voice, this form of the disease is recoved from in a few days, while neglect, constant talking, fresh colds, etc., develop it into a more serious affection.

B. In *moderately severe cases*—whether they have assumed this form from the start or have developed out of the milder variety in consequence of new exposures—the functional disturbance is more considerable; indeed in small children it may even be dangerous. The hoarseness becomes more marked, and may increase to aphonia. The patient experiences a burning pain, itching, or dryness in the larynx, and an inclination to clear the throat without being able to raise any considerable amount of mucus, and without the voice becoming any clearer. External pressure upon the sides of the larynx, or pressure backwards against the spine, is sometimes accompanied by painful sensations.

The *laryngoscopical examination* shows that the mucous membrane, especially upon the ventricular bands, is much congested and swollen; the vocal cords, which are thus partially

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[1] The term "ventricular bands" (Taschenbänder) is preferable to "false vocal cords," because, as Morell Mackenzie has suggested, the latter phrase "not only perpetuates the memory of a physiological error, but makes it necessary to qualify the real vocal cords by the term 'true.'"—TRANSLATOR.

concealed from view, have a slender appearance and a rosy hue, with here and there darker islands of injection or ecchymosis. The mucous membrane between and upon the arytenoid carti- lages, upon the epiglottis, and in the trachea, together with that of the ary-epiglottidean folds, is much swollen, and is sometimes of a uniform dark color, sometimes of a spotted redness, and occasionally its surface has a faint grayish hue, as if it had been brushed over with a solution of nitrate of silver (Türck), an appearance which is probably wholly due to cloudiness of the epithelium.

In *adults* dyspnœa does not occur, because, notwithstanding the considerable swelling of the mucous membrane on the ven- tricular bands, the inter-arytenoid region, etc., the width of the glottis is amply sufficient for respiratory purposes.

In *children*, however, even these moderate inflammations of the laryngeal mucous membrane may, although only tempora- rily, produce symptoms of the most severe inspiratory stenosis of the glottis.   It was on account of these peculiarities of catarrhal laryngitis in young children, peculiarities which are dependent upon the anatomical and physiological relations of the larynx in childhood, that Guersant proposed for this variety of laryngeal catarrh the name

Pseudo-Croup,

which has also been adopted by most recent writers, Bouchut, Friedreich, Ruehle, Duchek, etc.[1]

The paroxysmal occurrence of laryngeal stenosis at night, while during the day the symptoms are merely those of laryn- geal catarrh, is characteristic.   The first attack usually occurs suddenly on the second or third night after the patient has mani- fested the usual signs of a cold, such as cough and nasal catarrh.

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[1] I am willing to admit that the introduction of a name, which has only a semeiotic, or rather only a differential, diagnostic value, is opposed to the simplification of medical nomenclature ; nor is there any reason why here, as in all cases where it is possible, we should not be governed by the anatomical principle of classification.   The other names recommended by former writers, such as laryngitis spasmodica (Barthez and Rilliet), laryngitis and angina stridula (Bretonneau), asthma acutum (Millar), and asthma Mil- lari (Wichmann) might better be committed to oblivion, in order to put an end to the constantly recurring confusion.

The child awakes from sleep with a sense of suffocation, loud stridor in inspiration, a dull, barking, dry cough, alternating with a doleful cry, the voice hoarse and toneless, active movements of the accessory muscles of respiration, inspiratory sinking inwards of the epigastrium and false ribs, slight cyanosis, great restlessness, and anxiety. Examination of the throat shows the presence of simple catarrh without any croupous-diphtheritic membrane. The temperature is either normal or only slightly elevated.

With proper treatment the attack of laryngeal stenosis generally lasts but a few hours; the stridor gradually diminishes, and with it the dyspnœa; the breathing becomes more quiet; moist râles make their appearance in the chest; the patient perspires, and passes water more abundantly; and the drowsiness soon passes into a quiet slumber, interrupted from time to time only by a hoarse barking cough, which alarms the parents anew.

On the following morning the child is usually almost entirely well, and presents no symptoms except simple catarrh and slight hoarseness. In many cases the attack is not repeated; but not infrequently it returns the next night, without the course of the disease being thereby rendered more unfavorable.

The so-called attacks of croup are very apt to recur with every acute catarrh of the upper respiratory passages, and it is not uncommon to find children who are said by their parents to have had "croup" half-a-dozen times.

It is hardly necessary to say that in all such cases the affection was merely catarrhal, since recurrences of true croup are extremely rare. These attacks are merely an evidence of unusual vulnerability of the respiratory mucous membrane in children who have an hereditary predisposition to scrofula and phthisis, or who have been reared effeminately, and such attacks are therefore to be regarded as important indications for subsequent medical treatment.

C. The *severest form* of catarrhal laryngitis, which even in adults may induce symptoms of stenosis of the glottis and death, is very rare. The intensity of the process may manifest itself in several ways:

1. As *very acute laryngitis terminating in œdema of the*

larynx.   The rapidity and the great amount of swelling of the mucous membrane, together with the inflammatory œdema of the submucous connective tissue, produce a serious obstruction to the entrance of air.

Under the influence of a fresh exposure to cold, a wetting of the perspiring skin, or some other cause, a laryngeal catarrh, which at the outset is of a simple character, becomes aggravated, with a rapid increase of the catarrhal symptoms, burning pain in the larynx, dysphagia, etc., to the development of severe stenosis of the glottis, so that within a few hours life is seriously endangered, and death from asphyxia ensues if relief be not speedily afforded.

As long ago as Morgagni,[1] cases of this kind were described by him with the words, "Ingens ab hoc morbo periculum, utpote paucis nonnunquam horis hominem jugulat." Porter (l. c.), Ruehle (l. c., S. 50 et seq.), and Tobold (l. c., S. 161) mention cases of acute laryngeal catarrh which proved rapidly fatal by suffocation from œdema glottidis setting in at night, or even in the daytime; other cases are also recorded in which the fatal result was prevented only by energetic antiphlogistic treatment or by tracheotomy, as in Nos. 3 and 4 of Tobold's cases.

2. As *laryngitis hemorrhagica.*   The injection of the swollen mucous membrane is moderate in amount, and results either in extravasation of blood upon the free surface, with temporary amelioration of the symptoms of stenosis of the glottis, or in hemorrhagic infiltration of the mucous membrane and submucous connective tissue.   These cases are extremely rare. Reference has already been made in the section on laryngeal hemorrhage, p. 191, to the few cases of this kind on record.   It may, however, be mentioned here once more, that the symptoms of laryngitis hæmorrhagica may be so insignificant as to make a diagnosis possible only by a laryngoscopical examination in connection with the presence of streaks of blood attached to the expectorated mucus ; also that alarming stenosis may be produced either by the formation of a tolerably firm clot on the surface of the vocal cords—which is especially apt to happen when the extravasation is very gradual and occurs during the night—or by a considerable tumefaction of the soft parts from

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[1] De sedibus et causis morborum, Epist. XVIII.

hemorrhagic infiltration of the mucous and submucous tissues, giving rise to all the symptoms and results of œdema glottidis.

The diagnosis will depend mainly upon the inspection ; and when this is impossible, upon the presence of blood in the expectoration, and the decline of the symptoms of stenosis concurrently with the extravasation of blood.

3. As *laryngitis exanthematica*, or laryngitis secondary to the acute eruptive diseases. This form is very often met with during the course of acute infective diseases, especially the exanthemata. It is most common in *measles*, in which laryngitis is rarely entirely absent ; but it also occurs in *small-pox*, *typhus*, and *typhoid fevers*, *scarlatina*, and *erysipelas*. In these diseases the laryngitis usually presents a catarrhal character ; but the croupous-diphtheritic form of inflammation is by no means rare, especially in measles. In some epidemics of measles I have seen the laryngeal affection much more frequent and severe than in others ; in such cases delicate diphtheritic exudations upon the mucous membrane, and secondary superficial ulcerations have been comparatively common. Hitherto a true eruption upon the mucous membrane has been noticed only in small-pox, in which genuine variolous pustules and ulcerations may occasionally form, and extend from the throat to the larynx (Türck). I have made an autopsy upon one such case.

In *measles* a deep uniform redness of the mucous membrane of the laryngeal mucous membrane, with a yellow-reddish color of the vocal cords, has been observed with the laryngoscope by Stoffella,[1] and repeatedly also by myself. Whether the redness begins in a spotted form—as many authors suppose—or as a diffuse injection, cannot be determined in most cases. The symptoms of stenosis in the simple laryngitis of measles are frequently by no means inconsiderable, and if superficial diphtheritic exudations take place, quite common. Still the stenosis rarely reaches such a height as to require laryngo-tracheotomy ; at least in some twenty cases of laryngeal diphtheria from measles I have never found the operation necessary.

In *erysipelas*, especially when it affects the head, laryngeal

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[1] Wochenblatt d. Ges. d. Wiener Aerzte, 1862, S. 154.

catarrh is not uncommon.   This complication has been spoken
of by English physicians, who have paid particular attention to
this question (Gibson, Ryland, Gibb, Hinckes, Bird), as being
very frequent, and as generally preceding the outbreaks of the
erysipelas (sixty per cent. according to Bird).   The catarrh starts
from the throat, and extends thence to the larynx.   There is
nothing peculiar about the complication, except that not very
infrequently the ary-epiglottidean folds become slightly œdema-
tous.   In this way a rapidly increasing stenosis may be devel-
oped, which may prove fatal within a few hours ; but there are
very few recorded cases of the kind.   Among several hundred
cases of erysipelas of the face and head I have not seen a single
instance in which the laryngeal stenosis was at all alarming.   In
the chapter on Œdema of the Larynx will be found a description
of a mild case of œdema occurring during erysipelas under the
observation of Türck.

Laryngeal catarrh is a frequent complication also in both
typhus and *typhoid fevers*.   In the latter it is not uncommonly
accompanied or followed by more or less deep ulcerations, and
by perichondritis with laryngeal œdema, which runs its course
with extreme rapidity ; while in typhus it is rare for a simple
inflammation of the mucous membrane to result in œdema.
Moreover, the frequency of laryngeal affections in typhoid fever
has been very much diminished by the modern antipyretic treat-
ment, showing that the vulnerability of the laryngeal mucous
membrane is chiefly owing to the fever, and that the typhoid
ulcerations on the posterior commissure are pathogenetically
allied to bed-sores.

Analysis of Individual Symptoms.

The *derangement of vocalization*, which in slight cases is the
most noticeable symptom, varies, according to its anatomical
cause, from a simple huskiness or veiling of the voice to com-
plete aphonia.   Not infrequently the voice, without losing its
force, acquires an abnormal timbre, or an abnormally low or
high pitch.

These functional disturbances are produced by a variety of

acoustic conditions. A common cause, and one to which Gerhardt was the first to call attention, is that during phonation the inter-arytenoid mucous membrane protrudes as a fold between the vocal processes, so as to prevent not only their proper approximation but also that of the vocal cords. This mechanical interference with the movements of the arytenoid cartilages and vocal cords is, however, rather unusual. Still less frequent is a considerable degree of swelling of the mucous membrane lying between

FIG. 1.
Gaping of the Glottis in Phonation, from Incomplete Tension. Acute Laryngitis.

the anterior points of attachment of the vocal cords. Much more commonly the hoarseness depends upon a derangement, as yet unsatisfactorily explained, in the *innervation* of the *laryngeal muscles*, or upon an *alteration* in the *muscular substance* itself. The degree of hoarseness is by no means always in direct proportion to the inflammatory injection and swelling of the soft parts concerned in phonation. In many cases, besides a partial injection and swelling of the mucous membrane, there is to be noticed in phonation only a considerable gaping of the glottis, or a slight concaveness of the borders of the vocal cords (see Figs. 1 and 2). The *longitudinal* (and

FIG. 2.
Gaping of the Cartilages of the Glottis in Phonation. Acute Exacerbation of a Chronic Catarrh.

perhaps also the transverse) *tension* of the *vocal cords* is *incomplete*, and probably also *unequal*. This hypothesis of an inequality of tension would enable us to explain the frequent huskiness, jarring, and shrillness of the voice, for which in so many cases no satisfactory cause can be discovered by the laryngoscope ; these qualities being produced by the
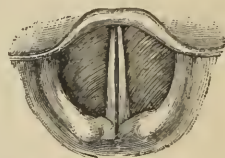
FIG. 3.
Swelling of the Ventricular Bands, and slight Gaping of the Glottis in Phonation. Acute Laryngitis.

vibrations of unequally tense membranes. Considerable swelling of the ventricular bands may also be an important impediment to the free movements of the vocal cords (see Fig. 3). This swelling may be so great that the ventricular bands almost completely cover the vocal cords, and approximate so nearly to each

other in attempts at phonation, that the vibrations produced in them by the forcible impulses of air give rise to a deep husky sound.

Dyspnœa is very rare in *adults*, and in simple laryngitis without implication of the perichondrium it occurs only in consequence of very considerable inflammatory swelling, and a simultaneous functional derangement in the action of the muscles which open the glottis (the posterior crico-arytenoid muscles). In *children*, the symptoms of laryngeal stenosis may occur even when the inflammation is only moderately intense. These attacks of stenosis are due partly to the relatively great amount of swelling of the mucous membrane in comparison with the narrowness of the true and false glottis, and partly to the secretion, which dries upon the parts during sleep, and increases the obstruction. The stridor is solely inspiratory, and the expiration takes place noiselessly. When the secretion is liquefied, and removed by the use of warm drinks or emetics, or by coughing, etc., the inspiratory stridor disappears rapidly, and almost entirely, and there are left only the loud bass cough and hoarseness. It is possible, nay probable, that in many cases the symptoms may be partly due to reflex spasms of the muscles which close the glottis ; still, the instances in which spasm of the glottis takes a prominent part are rare, and the symptoms of spastic stenosis, when they do occur, last but a very short time.

The *cough* is usually active and of a spasmodic character. Especially in young children it often occurs in paroxysms, which resemble those of whooping-cough, and are composed of several series of forcible expirations in rapid succession, followed by stridulous inspiration. In children—less frequently in adults—the cough has often a peculiar, deep, humming tone, which, according to some laryngoscopical examinations, which I have had the opportunity of making in these patients, is produced not by vibrations of the vocal cords themselves, which on account of their shortness are quite incapable of such large vibrations, even when completely relaxed, but rather by the movements of the swollen ary-epiglottidean folds, and of the arytenoid and Santorinian cartilages which are not properly fixed in position by the relaxed muscles. In adults the cough

during the early days of the attack has an impure timbre, and, when the swelling of the vocal cords is more considerable, it becomes entirely toneless. As soon as the muco-purulent secretion increases in quantity the cough becomes moist, and has the ring of a cough that is loosening, in consequence of the vibrations of the masses of mucus.

The *secretion* of the mucous membrane is at first very scanty, almost entirely mucous, clear, transparent, watery, and deficient in mucus cells. It contains a few formed epithelial cells, and sometimes red blood-corpuscles. Not infrequently blood may be seen by the naked eye in the form of small streaks. The amount of secretion is often so small that no sputum can be obtained for examination. After a few days the secretion becomes more abundant and consistent, and more yellow from the increasing number of pus-cells. In general its quantity is inconsiderable in consequence of the small extent of surface affected by the catarrh.

Dysphagia occurs only when the epiglottis and the posterior surfaces of the arytenoid cartilages and ary-epiglottidean folds are considerably implicated in the inflammation.

The amount of *pain* and disagreeable feeling of dryness, or irritation, as if from a foreign body, varies considerably, being sometimes very slight even when the inflammatory symptoms are quite severe, and in other persons very annoying, although the inflammation is but trifling. As Tobold suggests, the greater or less sensitiveness of the individual has undoubtedly much to do with this difference.

The *general malaise* also varies much in different individuals. While nervous sensitive persons are much alarmed, and have to keep to their rooms and to their beds, we often see those who are more robust attending to all the details of their business.

Moreover, the pain appears to be produced, not so much by the direct contact of food with the inflamed parts, as by the mechanism of the closure of the glottis in the act of deglutition, that is, by the firm pressure of the under surface of the epiglottis, especially of the cushion (tubercle) of the epiglottis, upon the inflamed mucous membrane of the upper aperture of the larynx (Semeleder).

Diagnosis.

The *diagnosis* of acute laryngitis, as a rule, presents no difficulties. The history of the case, the subjective and objective symptoms, and especially the changes discoverable by laryngoscopical examination, usually make a certain and exhaustive diagnosis practicable from the outset. In many cases, to be sure, the diagnosis of acute catarrh of the larynx may be made without the laryngoscope, but such a diagnosis cannot be exhaustive. The special localization of the inflammatory changes, as well as the rarer sequelæ and complications, such as muscular pareses, ulcerations, small neoplasms, and œdemas, cannot be recognized without a laryngoscopical examination. I cannot, therefore, too urgently recommend that, *as a matter of principle, every laryngeal affection, even those which appear to be the most trifling, should be followed up laryngoscopically.* Only by observing this rule can we obtain an insight into the great variety of lesions, which enter into the picture of a disease apparently so simple as acute laryngeal catarrh, and only in this way can we obtain certain and speedy curative results.

In *childhood* the awkwardness, and frequently, also, the obstinate resistance of the little patient, and the excessive sympathetic tenderness of the mother, render the diagnosis more difficult; but with sufficient practice, dexterity, and patience, one can very often succeed, even in young children, in obtaining a full view of the changes in the larynx. Such, at least, has been my own experience in many instances,[1] and it is confirmed by the recent reports of Klemm.[2]

Laryngoscopy is especially serviceable in the differential diagnosis between pseudo-croup and true croup. I have repeatedly succeeded in making the diagnosis at once by inspection with the mirror—a point of very great importance in obscure cases, in reference to the prognosis and treatment, and especially for the purpose of quieting the fears of the parents.

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[1] See *Ziemssen:* "Ein laryngoskopirter Croupfall," Greifswalder medic. Beiträge, Bd. II., S. 123, 1864.

[2] *Klemm.* Laryngologisches aus der Kinderpraxis, Jahrbuch für Kinderheilkunde, N. F., Bd. VIII., S. 360 et seq.

When the inflammatory stenosis has made rapid progress, an accurate diagnosis is difficult, and, in fact, often impossible, on account of the urgent dyspnœa interfering with the laryngo-scopical examination. In this case the question must be decided by the history of the case, the subjective and objective symptoms, and especially by digital exploration of the entrance to the larynx for œdema or foreign bodies.

Course, Duration, Results, and Prognosis.

The course of acute laryngitis under proper treatment is favorable and rapid. Its duration extends in the mildest forms from five to eight days; in the moderately severe, from eight to fourteen days; and in the most severe, from two to three weeks or longer. Under injudicious treatment, especially if the vocal organs be not spared, and the patient contract fresh colds, or be exposed to other injurious influences, the disease may last for a much longer time and assume the character of a chronic laryngeal catarrh. In children with a vulnerable laryngeal mucous membrane—whether the disposition to respiratory affections be transmitted from phthisical parents, or be acquired in consequence of effeminate rearing—even the mildest catarrhs of the larynx frequently take on the form of pseudo-croup, but they almost always terminate favorably. A fatal result in pseudo-croup is extremely rare.

It must be borne in mind, also, that a simple catarrhal laryngitis may be converted into the croupous-diphtheritic form in otherwise healthy children, and in patients with measles or small-pox: this possibility of course materially affects the prognosis.

In the severest form of inflammation its termination in œdema of the larynx is to be inferred, if symptoms of stenosis of the glottis supervene upon those of a simple catarrh, and if the asphyxia reach a dangerous height in the course of a few hours. The prognosis in such cases depends essentially upon the efficiency and promptness of the treatment, and especially upon the employment of tracheotomy.

Treatment.

Both in adults and children, when there is a marked predis-position to catarrhs, the prophylaxis against acute laryngeal catarrh becomes a matter of importance.   Above all, care should be taken to diminish the sensitiveness of the respiratory mucous membrane, as well as that of the skin, to the influences of the weather, and this all the more because the frequent recurrence of catarrhs leads to an excessive timidity and caution in regard to clothing and enjoyment of fresh air.

In such cases it is well to have the whole body rubbed every morning with a large sheet, which has been previously dipped in cold water, and carefully wrung out.   As the patient gets out of bed his night linen is removed, and the sheet, which is held spread out, is thrown around him from behind so as to cover the head, but not the face, and the whole body down to the feet. A gentle rapid friction of the skin by rubbing with the sheet will diminish the unpleasant impression from the cold moisture. After one or two minutes of this friction the wet sheet is removed, a warm dry one is thrown about the body in the same way, and the body is dried.   The patient then puts on his clothes, and immediately takes out-door exercise, whatever the weather.

If the skin be very delicate I modify the treatment by at first giving the water, into which the sheet is dipped, a lukewarm temperature (about 86° F.), and then lowering the temperature two degrees daily until it reaches that of spring water (50° to 56°).   This treatment I have adopted for several years, with the best results for children as well as adults, and the patients never catch cold, if the rubbing be done in a warm room with the feet resting upon a woollen rug.   After using this treatment for eight days the patient may be allowed to wear less clothing.   During the winter he may continue to use a fine woollen underjacket, notwithstanding the frictions, but in the spring this garment must by all means be discarded, and about this time the cold frictions are to be resumed—if they are not employed both winter and summer, as is advisable in the case of children.

In the course of the summer it is very desirable that the

patient should spend five or six weeks at the sea-side in order to obtain the hardening effects of sea-bathing. This plan should, however, be preceded by a course of friction treatment at home, so that the bathing and out-door exercise may be resorted to immediately without restriction and without anxiety on the part of the relatives. The moisture and motion of the air on the sea-coast not only diminish the sensitiveness of the skin and respiratory mucous membrane, and enable the patient to remain out of doors all day without the danger of catching cold, but, in connection with the bathing, they also aid the general health by improving the appetite and increasing the metamorphic changes in the body.

If sea-bathing be impracticable, tepid salt-water baths (77° to 88°) of from ten to fifteen minutes' duration, with gentle friction, may be recommended.

It is important also to avoid wearing very thick neck-kerchiefs at night, or thick shawls by day.

Persons who are obliged by their occupations to talk or sing much, and in a loud tone, as, for instance, teachers, clergymen, and vocalists, should be urgently advised to spare their vocal organs as much as possible during the practice of their professions, and also to abstain entirely from speaking or singing for a certain length of time during the year. Many vocalists would be able to preserve their voices longer, if, during their vacation, they rested the larynx, instead of straining it excessively by being obliged to entertain their hosts.

Treatment of laryngitis during the attack. Among the injurious influences whose prevention is the first condition for the treatment of laryngitis, those of a mechanical and atmospheric-thermal character occupy the first rank. In particular the detrimental effect of the *mechanical* irritation of the glottis and the neighboring parts induced by *talking* has been much underestimated. The more the vocalizing power of the vocal cords is diminished by the swelling of the mucous membrane and by the other anatomical changes previously mentioned, and the louder the tone which the catarrh renders necessary, the more considerable become the compression and irritation of the mucous membrane, because an excessive action of some of the

laryngeal muscles is required to compensate for the mechanical impediments. Any one who has had much experience with laryngeal disease can often, during the course of treatment of a laryngeal catarrh, at once discover by the mirror that the patient has the day before strained his vocal organs, and it is my conviction that some of the paralyses of the vocal cords are due solely to this cause.

Moreover, the mechanical irritation of the mucous membrane thus induced favors not only the aggravation of the catarrh and the production of muscular pareses and paralyses, but also the chronicity of the catarrh and the development of local proliferations upon the mucous membrane, however judicious the treatment in other respects. The prohibition of all talking and singing cannot be too urgently insisted upon, nor carried out with too much strictness.

When the catarrh is accompanied by high fever the injurious influences of changes in the temperature of the air should be avoided by keeping the patient in bed, and by maintaining a uniform temperature in the room (63° to 66° F.). In the milder cases the patient should at least keep to his room in unfavorable weather.

When fever is present, and the mucous membrane of the nose, throat, trachea, and bronchi are also affected, mild diaphoretic treatment is advisable, such as elderberry tea, or an infusion of jaborandi, six drachms to the pint.

Wadding or a Preissnitz compress may be used around the neck. There is generally no occasion for any special antiphlogistic treatment.

For the relief of the irritable cough and the uncomfortable feeling of dryness in the throat, an infusion of marsh-mallow or expectorant herbs, warm sugar and water, or hot milk and Selters water in equal parts are generally sufficient. Small doses of morphine have also an excellent effect, as one-thirtieth of a grain of muriate of morphia given every hour or two in a mixture of the emulsion and the syrup of almonds. For children the dose is to be correspondingly diminished.

Very happy results are also to be obtained by spraying the throat several times daily with a solution of morphine in bitter

almond water, or with a solution of bromide of potassium, twenty grains to the ounce, or of chloride of sodium, twenty-five grains to the ounce, for the purpose of liquefying the tough secretion and relieving the feeling of dryness and irritation.

As the case progresses expectorants may be used, such as muriate of ammonia, water of ammonia, or, if necessary, narcotics in small doses, as one-fortieth of a grain of muriate of morphia every three hours in a mixture containing liquorice and spirit of ammonia.

This treatment is sufficient in most of the mild and moderately severe cases of idiopathic laryngitis, and also in the catarrhs which accompany measles and other infective diseases.

In *severe* cases antiphlogistic treatment may be necessary in the form of cold compresses, an ice bag about the neck, or the frequent swallowing of ice-water or pieces of ice. Leeches to the larynx in adults, or to the manubrium sterni in children, are generally undesirable. If cold water cannot be borne, poultices may be used, or hot-water compresses (Ruehle), or large sponges dipped in hot-water. To prevent evaporation and rapid cooling these applications should be covered with rubber cloth.

The treatment of acute laryngitis by strong counter-irritants, especially by the blisters, which are highly recommended by French and Russian writers, has met with no approval in Germany. The rapid counter-irritation from mustard plasters is, however, unobjectionable.

For the direct local treatment of the mucous membrane solutions of morphine, bromide of potassium, or chloride of sodium may be used by inhalation, as previously recommended, or the parts may be painted with the wine or tincture of opium, or with a solution of morphine, bromide of potassium, etc. Astringents (nitrate of silver, tannin, alum) are unadvisable in the acute stage ; still more objectionable is the attempt to abort the disease by local applications of strong solutions of nitrate of silver, etc.

Internally, narcotics in mucilaginous vehicles are to be preferred. Very happy results are also often obtained—and on this point I agree entirely with Ruehle—by derivation to the intestines, especially in full-blooded adults, by means of castor-

oil, croton-oil, the confection of senna, or "bitter water." In children caution is necessary, and as a rule calomel is to be preferred.

If paresis of the muscles is developed, the electric current may be used in both forms percutaneously, in addition to the remedies mentioned above.

When symptoms of marked stenosis occur—in children under the form of pseudo-croup—an emetic is also indicated, such as pulv. ipecac with tart. emetic, apomorphia or sulphate of copper. By this means the paroxysms of severe dyspnœa are usually speedily relieved. If the laryngeal stenosis still continue to be alarming, and the laryngoscopical inspection, as well as the digital exploration, show the presence of œdema glottidis, the attempt should be made to scarify the œdematous parts (with the aid of the mirror), and if this operation be not followed by rapid relief of the stenosis, tracheotomy should be performed without delay.

LARYNGITIS CATARRHALIS CHRONICA.

CHRONIC CATARRH OF THE LARYNX.

ETIOLOGY.

Chronic laryngeal catarrh generally proceeds from an acute attack, as a result of neglect or of exposure to those injurious influences which have been referred to above as prolonging the inflammatory process. Among these causes none is more prejudicial than the mechanical irritation of the laryngeal mucous membrane by speaking or singing, especially in a loud voice, as is so frequently the case with over-zealous professional speakers, teachers, clergymen, singers, popular orators, landlords, and other professional persons. Many persons sin to an incredible extent against their vocal organs, as if they were indestructible, and, even when the voice is quite gone, try to make themselves understood by severely straining the larynx.

Another extremely frequent cause of chronic laryngeal ca-

tarrh is *chronic pharyngitis*, which is especially apt to extend
to the larynx when several causes co-operate, such as straining
the voice by loud talking, the abuse of tobacco, and alcoholic
stimulants, etc. Inveterate topers almost always suffer from
chronic pharyngeal and laryngeal catarrh.

Stokes and other writers would give us to understand that
chronic catarrh is often due to the mechanical irritation of the
epiglottis and entrance to the larynx by the tip of an *elongated
uvula*, which they advise in such cases to be amputated. But
no evidence has hitherto been adduced that an elongated uvula
can produce such an irritation ; and as Ruehle has remarked,
both the uvular enlargement and the laryngeal catarrh are to
be regarded as co-effects of the same cause—the chronic pha-
ryngitis.

The dusty atmosphere which is generated in various occu-
pations—millers, weavers, hare-wool cutters, stone-masons, glass-
polishers, tobacco-workers, miners, etc.—appears to have but a
slight effect upon the laryngeal mucous membrane ; at least
Sigaud, Ramazzini, Fourcroy, Hirt, Merkel and other writers do
not ascribe much importance to this cause.

As regards *age* and *sex*, primary chronic catarrh of the
larynx is more frequent during the middle years of life than in
childhood or advanced age, and in men far more frequent than
in women. The reason for this probably lies in the greater fre-
quency, variety, and intensity of the injurious influences to
which men are exposed in the pursuit of their occupations.

As a secondary affection chronic catarrh occurs in connec-
tion with all the different pathological processes in the larynx
which are of long continuance, with the destructive processes in
phthisis, typhoid fever, syphilis, lupus, and also with polypi, can-
cer, and perichondritis laryngea. The fact that chronic catarrh
often develops as an accompaniment of ulcerative changes in the
mucous membrane, even from the very beginning of the latter,
has given rise to the erroneous opinion that chronic catarrh has
a natural tendency to result in ulceration. Simple chronic
laryngeal catarrh, however, even when of long standing and con-
siderable intensity, does not lead to ulceration, as was formerly
supposed by Engel, Ruehle, and other trustworthy writers.

PATHOLOGY.

Symptoms, Anatomical Changes, and Terminations.

Primary chronic catarrh of the larynx exhibits all the peculiarities which are seen in chronic catarrh of the throat and other portions of the respiratory mucous membrane : especially the tendency to hyperplasia of the mucosa and submucosa when the disease lasts a long time, with but a very slight disposition to superficial ulceration ; the tendency to extend along the surface ; and finally, the same tedious course and obstinacy to treatment.

It begins either as an acute catarrh, which from continued exposure and neglect assumes a chronic character, and is continually being rekindled into acute exacerbations ; or in an insidious form, with insignificant symptoms, which are chiefly subjective and then gradually developing more marked objective disturbances in phonation, in the tone of the cough, and in rare cases also in the respiration.

The *subjective* symptoms, which so frequently mark the beginning of the disease, consist in a feeling of dryness in the throat, itching and an uncomfortable irritation, which compels the patient to clear his throat, to cough, and to swallow frequently. These abnormal sensations are aggravated by talking, singing, and smoking, and are relieved by resting the vocal organ, by drinking warm fluids containing sugar and mucilaginous substances, or by the use of cough syrups, cough candy, etc. Actual pain in the throat, or a feeling of excoriation, is not complained of except after long-continued talking, and disappears when the voice is rested. In acute exacerbations pain of some severity may occur spontaneously, or may be produced by attempts at phonation, and by external pressure.

The *objective* disturbances consist chiefly of *alterations* in the *voice* in various degrees, according to the intensity of the catarrh. In the lightest cases the voice is generally clear, and of normal timbre and force, but easily becomes altered by talking, or by masses of mucus, which are either situated on or near the vocal cords, or extend from one vocal cord to the other in the form of

whitish threads. Such patients, on long talking, are usually obliged to repeatedly clear their throats, and also to drink frequently. In severer cases the voice is clear only in the morning after the night's rest, and after the removal of secretion by hawking ; but as soon as the voice begins to be used it becomes husky, and the patient is obliged to be continually clearing his throat, and to strain the expiratory and vocal muscles. In the evening, especially if the voice have not been used excessively, and if beer or tea have been taken freely, all these derangements are reduced to a minimum, but only to return the next morning with the first word spoken.

In the severest forms of the uncomplicated chronic catarrh the voice is quite hoarse, deep, and rough, or abnormally high, and easily changes to a falsetto (vox anserina). Talking is possible only with great muscular exertion, because, as the vocal cords are no longer able to close and vibrate with their usual facility, the expiratory current of air must be urged forward under very high pressure in order to excite the vibrations of the glottis ; in general a pure tone can no longer be produced. The patient is obliged to hawk and cough for hours every morning to relieve the troublesome irritation in the larynx.

The *secretion*, in its total amount, is scanty, but relatively to the small size of the secreting surface it is considerable. The mucus is whitish gray, frothy with minute bubbles, viscid and thread-spinning (fadenspinnend), often clear and vitriform, and in cases of long standing contains numerous pus-cells, which give it a rather yellowish color. It rarely contains blood, and then generally in small streaks during acute exacerbations.

The *irritation which excites cough* is urgent, and the tone of the cough deep, hoarse, and of an unusual timbre.

The anatomical changes, as seen by *laryngoscopical examination*, present the most varied appearances, according to the severity of the disease, from a slight swelling and injection of the mucous membrane, limited in many cases to certain parts, such as the vocal processes, the inter-arytenoid region, the edges of the vocal cords or the ventricular bands, up to the deepest uniform redness, with a bluish or brownish lustre, diffused over the whole organ, a velvety sponginess of the mucous membrane and swell-

ing of the submucosa, with diffuse uniform thickening of the epiglottis, ventricular bands, and inter-arytenoid region. The tumefaction of these different parts interferes seriously with vocalization. Thus the hypertrophied inter-arytenoid fold may, by its interposition between the arytenoid cartilages during phonation, prevent the normal approximation of the same, and that of the vocal cords. So also the swollen ventricular bands not only obliterate the ventricles of Morgagni, and cover over a large part of the vocal cords, but also materially lessen the excursions of the latter during phonation. Moreover, the swelling of the mucous membrane of the epiglottis, and the imperfect mobility of this organ, which is thus produced, have much to do with the abnormal timbre.

The redness from congestion is usually less noticeable upon the vocal cords than upon other portions of the mucous membrane. The swelling and thickening of the vocal cords may be recognized by the granular condition of their surfaces, the unevenness of their edges, and the magnitude of their vibrations.

Very generally *motor derangements* can be detected by the laryngoscope. These consist either in a mechanical interference with the movements of the arytenoid cartilages and vocal cords from thickening of the mucous membrane and submucosa, or in true muscular pareses, which are more frequently unilateral than bilateral, and which can be recognized by the fact that the two arytenoid cartilages and vocal cords move less freely than usual in phonation, and probably also in respiration. The vicarious activity of the healthy vocal cord frequently obviates the difficulty in the closure of the glottis in phonation by carrying the cord over beyond the median line, thus giving the glottis the necessary narrowness, though at the same time an oblique direction (see *infra*, "Diseases of the Laryngeal Nerves and Muscles ").

Erosions are of rather rare occurrence, and true ulcerations in simple chronic catarrh are extremely uncommon.

Among the rarer lesions may be noted *partial* thickenings of the mucous membrane and submucosa on the epiglottis, ary-epiglottidean folds, ventricular bands, arytenoid cartilages and vocal cords. In these cases one is struck, on the first glance into the

larynx, by the great tumefaction of the several parts, sometimes amounting to distortion. This appearance is more frequent on the epiglottis, ventricular bands, and ary-epiglottidean folds than elsewhere. The epiglottis is irregularly thickened, very much bent, and covered with dilated veins. The ventricular bands overlie the vocal cords almost completely, and usually allow only the internal border and cartilaginous portions of the latter to be seen. Lewin has called special attention to the thickening of the ary-epiglottidean folds, and has pointed it out as a frequent peculiarity of preachers. These persons, he says, produce the deep, hollow tones, which express pathos, by forcibly depressing the epiglottis through contraction of the muscular bundles running in the ary-epiglottidean ligaments ; and the habitual tension of these folds, by interfering with the circulation, is said to lead to their thickening, and, according to Lewin, perhaps also to the atrophy of the epiglottis, which is sometimes noticed.

The marked *development of veins*, above alluded to as common on the epiglottis, occurs also in rare cases upon the vocal cords along their borders, upon the ventricular bands, and elsewhere. Morell Mackenzie regards this "*phlebectasis laryngea*" as the result of a constitutional anomaly, and the hoarseness as the result of the phlebectasis—a supposition with which I cannot agree. Duchek has opposed this view, and is probably correct in his statement that the dilatation of the veins and the aphonia are both caused by the chronic catarrh.

The alterations produced in the *vocal cords* by chronic catarrh may be very varied. Usually the only changes noticed are an irregular dirty-red injection, a fine, dark-red edge on the border of the cord, and in very protracted cases a roughness of the surface, which seems to be due to a partial dermoid metamorphosis of the mucous membrane. This latter lesion has been called by Türck sometimes *chorditis tuberosa*, sometimes *trachoma of the vocal cords*. Wedl examined such a trachoma microscopically, but could find nothing except hypertrophied connective tissue and heaps of nuclei.

At other parts of the mucous membrane where there are numerous glands, the *hypertrophy of the glands* may produce a

granular condition, known to the older writers as *laryngitis granulosa*, and analogous to the pharyngitis granulosa, with which it is often found associated.

In very protracted and maltreated catarrhs the affection frequently results in the formation of *papillary proliferations* and *polypi*, which will be considered more fully hereafter under the head of Neoplasms.

The favorite situation of *catarrhal erosions* is on those parts where the mucous membrane is most exposed to injury, viz., between the arytenoid cartilages, and upon the so-called glottis cartilaginea.

In very rare cases the chronic catarrh leads to *hypertrophy of the connective tissue of the under surface of the vocal cords*, a condition known as *chorditis vocalis inferior hypertrophica*. This consists in a true induration of the mucosa and submucosa on the under surface of the vocal cords, from hyperplasia of the connective tissue, whose contraction may, and in fact usually does produce, after a time, a high degree of laryngeal stenosis. Rokitansky [1] refers to this result of inflammation as an indurative degeneration (callosity), and says that this degeneration of the mucosa and submucosa into a callosity occurs in a particularly massive form in the neighborhood of the glottis, and gives rise to an ultimately fatal stenosis.

Shortly after this statement was made, Czermak [2] published a case of this kind, the first in which the diagnosis was made by the use of the laryngoscope.

The patient was a scrofulous girl, eighteen years of age, who had previously had enlargement of the cervical lymphatic glands, and of the entire anterior region about the larynx. Hoarseness occurred with dyspnœa, and the latter gradually increased to such a degree as to necessitate tracheotomy. After the operation, and notwithstanding the use of bougies, etc., the stenosis produced by the subchordal hypertrophy became more and more severe, and ultimately the lumen of the larynx was hermetically closed.

Gibb [3] has published one, and Türck [4] two cases of this kind.

[1] Lehrbuch der patholog. Anatomie, III. Aufl., Bd. III., S. 16.
[2] Der Kehlkopfspiegel, II. Aufl., 1860, S. 163.
[3] On Diseases of the Throat and Windpipe.   London, 1864, p. 119.
[4] Klinik der Kehlkopfkrankheiten, S. 204 ff.

The second one of Türck's cases is especially important on account of the spontaneous retrogression of the process.

Chronic Swelling of the Under Portions of the Vocal Cords—Tracheotomy—Subsequent Reduction of the Swelling.—Girl fourteen years of age. Without apparent cause, difficulty in breathing occurred, which in the course of six months gradually increased, and finally was attended by aphonia, cough. and suffocative attacks. The fissure of the glottis appeared to be narrowed, and at the same time shortened, by pads which projected beneath the vocal cords (see Fig. 4). Tracheotomy was performed for relief of the long-continued suffocative attacks. Eight months afterwards, when the breathing with the tracheal canula closed had become much improved, the laryngoscopical examination showed that the lumen of the stenosed part between the longitudinal pads, which projected beneath the vocal cords, had been considerably widened. When the stenosed part was examined with the mirror in an oblique position, and the larynx at the same time pushed to one side, it was found that the borders projected very distinctly above, but became more and more flattened towards the bottom, and that consequently the stenosis proceeded, not from a membrane, but from a rolling of the internal surfaces and part of the anterior surface of the posterior wall of the larynx into the form of pads. At the last examination the fissure was about 4''' long, and 1½''' broad at the widest part. Below could be clearly seen the canula (see Fig. 5, in which the canula appears below as a white hemispherical projection).

FIG. 4.

FIG. 5.

Scheff[1] has also published a case, but the final result is unknown.

Gerhardt[2] has recently published a very interesting case, in which also life was saved by laryngo-tracheotomy.

The patient was a female operative, thirty years of age. The affection began in the summer of 1870, with hoarseness, unaccompanied by cough or dysphagia. No cause could be discovered, but syphilis could be eliminated with certainty. During the winter the occurrence of pregnancy aggravated the hoarseness, and dyspnœa supervened. By the middle of March, 1871, the dyspnœa had increased so much as to prevent sleep. She was received into the Jena Clinique much emaciated, com-

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[1] Wiener med. Presse, No. 51, 1871.

[2] Deutsches Archiv f. klin. Med., Bd. XI., S. 584 ff., 1873.

pletely aphonic, and suffering from intense laryngeal dyspnœa, with noisy respiration. The vital capacity was 1400 c. cm. Swallowing and talking were very difficult on account of the dyspnœa; there was little or no fever. On laryngoscopical examination, there was seen lying by the side of each vocal cord, and projecting downwards from its internal border, a pale-red, slightly roughened pad, more prominently developed anteriorly, which on quiet breathing closed the glottis at all points, except posteriorly, where a fissure was left about one-half a ctm. in length, and three mm. in breadth.

Four days after admission, a suffocative attack, with convulsions, made it necessary to resort to laryngo-tracheotomy. On July 1 she was discharged, and afterwards had an attack of varioloid, so that the cavity of the larynx was not again examined until November. The movement of the vocal cords for closing the glottis was strong and complete, but for dilatation—feeble and unsatisfactory. The longitudinal pad, which projected downwards and inwards from each vocal cord, and narrowed the glottis, appeared to be separated from the yellowish white upper surface of the cord by a very shallow longitudinal furrow, but was covered with an unchanged pale, red, mucous membrane. It extended also to some extent over the anterior and posterior commissures, so that the glottis seemed not only narrowed, but shortened.

Repeated scarifications of the pad gradually diminished the swelling so much that the tracheotomy canula could be closed as long as five hours at a time, and the voice was restored, but still remained hoarse.

Burow, Jun.,[1] not long ago stated that he had seen in all six cases of chorditis vocalis inferior hypertrophica. In each tracheotomy became necessary on account of the urgent stenosis.

Here, therefore, although rarely, we find chronic laryngitis resulting in hypertrophy of the connective tissue on the under surface of the vocal cords, a condition of great clinical importance, on account of the stenosis to which it leads in the course of a few months. The diagnosis in these cases is to be based chiefly upon the laryngoscopical examination, but also upon the history of the case and other symptoms.

Ulcerations, *perichondritis*, and *œdema* are very rare results of chronic laryngitis (see *infra* in the section on these affections).

The *chronic secondary laryngitis*, which is dependent upon syphilis, ulcerative processes, neoplasms, traumatic irritations, perichondritis laryngea, or upon the compression or displacement of the larynx by a goitre, does not differ essentially in its symptoms from the primary chronic catarrh of the larynx, but,

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[1] Langenbeck's Archiv, Bd. XVIII., S. 228.

as a matter of course, the clinical picture is frequently much altered by the primary affection.

Course and Prognosis.

The course of chronic laryngeal catarrh is always very variable and tedious. Improvements and aggravations may rapidly follow each other according as the affection is modified by external circumstances, the habits of life, and the medical treatment. Care in using the vocal organ, as regards talking, singing, smoking, and drinking, favorable atmospheric influences, local treatment of the mucous membrane with astringents, etc., may speedily produce such an amelioration of all the symptoms that the patient thinks himself entirely rid of his complaint. But when he resumes his customary mode of life he discovers his mistake. Even the slightest excess rekindles the inflammation, which soon becomes as severe as ever. Hence, the common experience that, in patients who do not possess the energy necessary for a long course of medical treatment, and precaution for the sake of an apparently unimportant and innocuous affection, the catarrh often continues to vacillate between better and worse for years together. The absence of all constitutional symptoms, and the conviction of the harmlessness of the disease naturally make the patient indifferent to the representations of the physician. The extreme solicitude and pertinacity of consumptives in visiting the laryngeal specialist are strikingly in contrast with the heedlessness of patients with chronic laryngitis, who are otherwise perfectly well. A week or a fortnight's precaution and local treatment they regard as a very great sacrifice, even although such lesions as granular thickenings, papillary excrescences, polypi, and muscular pareses have already developed. To this rule, however, there is a marked exception in the case of the hypochondriacal patients, with pharyngo-laryngitis, among clergymen, teachers, and other professional speakers, who are harassed by the fear of consumption, and who actually become a burden to the specialist.

When serious anatomical changes have once become established, these in their turn help to maintain a condition of irrita-

tion.   This is the case particularly with polypi, which keep the
surrounding mucous membrane in a state of continual irritation;
while in muscular pareses the excessive exertion on the part of
the sound muscles during phonation cannot fail to inflict injury
upon the mucous membrane and submucosa.

Even in favorable cases the larynx remains a *locus minoris
resistentiæ*, so that acute attacks of laryngitis occur from com-
paratively slight causes, and always run a protracted course.

A perfect and permanent cure is, however, by no means a
rare occurrence, but such a result presupposes, at least in invet-
erate cases, persistent care on the part of the patient and on
the part of the physician large experience and dexterity.

Death from this cause is extremely rare, and results either
from the above-mentioned connective-tissue hypertrophy of the
under surface of the vocal cords, producing stenosis, or from
the equally rare lesions, perichondritis and œdema.

Many writers, and recently again Tobold,[1] have supposed
that simple chronic laryngeal catarrh may, if neglected, lead
to phthisis of the larynx and lungs, but this conclusion rests
upon false premises.   Chronic laryngitis produces as little
disposition to phthisis of the larynx as simple chronic bron-
chitis does to phthisis of the bronchi and lungs.

Tobold states that "the mild form of simple chronic laryngitis, even in robust
persons, if it last for several years, or be continually renewed by fresh exposures,
may terminate in ulcerative and tuberculous laryngitis, with a general phthisical
infection of the hitherto sound lungs."   This opinion he regards as confirmed by
the experiments of Sommerbrodt; but erroneously, because these experiments
merely show that ulcerations and suppurations artificially produced in the larynx
may give rise to purulent peribronchitis and pulmonary phthisis, but furnish no
evidence in regard to the results of simple chronic catarrh.   Sommerbrodt in his
work has nowhere anything to say in favor of pulmonary phthisis originating in
simple catarrh.

That chronic catarrhs do accompany destructive processes in
the larynx is undeniable; we are not concerned however, with
these secondary affections at present, but rather with those of a
simple idiopathic character.   As to which of these two forms is

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[1] L. c., p. 179.

present in any given case, it is, of course, in many cases exceedingly difficult to decide (see *infra* in the article on Destructive Processes).

TREATMENT.

In the first place all those injurious influences are to be avoided which are apt to produce or protract a laryngeal catarrh. Accordingly, every mechanical irritation of the mucous membrane, by speaking or singing, is to be specially guarded against. Teachers, clergymen, singers, actors, and other persons who are obliged by their occupation to use their voices to excess, should at once take a vacation for several months, because absolute rest of the vocal organ is indispensable for a complete cure. In many cases it will require the whole of one's professional authority to enforce so stringent a regulation. But it is not sufficient that the patient be condemned for a time to silence; he must also avoid smoking, or staying in rooms filled with tobacco smoke; and he must give up using snuff, spirituous liquors, or highly seasoned food, because any irritation of the mucous membrane of the pharynx always revenges itself upon that of the larynx.

The treatment is mainly local. The application of the stronger astringents should always be made by the physician himself, and with the aid of the laryngoscope, as the eye is the only safe guide for the instrument. The weaker astringents are generally ordered in solution, and inhaled by the patient in the form of spray generated by one of the numerous inhaling apparatus.

I prefer Siegle's spray apparatus, which works uniformly and safely. The patient should be personally instructed how to use it, how to hold the head and mouth properly, and how long the inhalations should last. These I never allow to be continued for more than four or five minutes, and usually only twice daily. When a tannin solution is used, the minute opening at the end of the glass tube may easily become occluded by flakes of tannin. This may be remedied by placing the glass tube for some time in warm water or in alcohol, in order to dissolve the hardened tannin. Drilling with needles, wires, etc., is almost certain to break the fine glass tube.

Among the astringents which may be used by inhalation tannin is probably the best. Solutions of five grains to the

ounce may be employed. If there is much irritability of the mucous membrane of the larynx and throat, it is well to begin with solutions of potassium or sodium salts, for the purpose of first relieving the hyperæsthesia, and of increasing and lique-fying the secretion. These indications are best fulfilled by inha-lations of solutions containing from twenty to twenty-five grains of bromide of potassium to the ounce, and also by solutions of common salt.

In general, however, too much must not be expected from the use of inhalations in chronic catarrh of the larynx and throat; they are adapted, when used alone, only to the mildest cases, and in the moderately severe and severe cases they should be regarded merely as an aid to the rest of the treatment.

Among the *stronger astringents* I give a decided preference to *nitrate of silver*, because it can be locally applied in sub-stance with perfect ease and safety, and because it can be kept in solution in any degree of concentration. In very inveterate catarrh of the larynx and throat I always use the remedy in substance.

Every time the application is to be made I cover the grooved knob of the curved caustic-holder with the melted caustic, in the way first recommended, if I am not mistaken, by Lewin. The caustic is melted in a small porcelain saucer over a moderate flame; the knob of the caustic-holder is then quickly dipped in, and becomes coated, if the liquid be not too thick nor too thin, with a thin layer, just sufficient for one application. Then, guided by the mirror, I pass the instrument into the larynx, and rapidly and superficially touch the parts most congested and thickened. The spasmodic contraction which immediately ensues in the muscles, closing the entrance to the larynx, spreads the caustic action, and for several minutes there is a very active spasm of the glottis, which is soon relieved, however, by drinking a little cold water. If the parts be examined immediately afterwards, the upper surface of the vocal cords and ventricular bands will be seen to be skimmed over by a tolerably uniform gray layer, from the action of the caustic. On the upper soft parts of the entrance to the larynx, *e.g.*, the mucous membrane of the arytenoid cartilages, or the ary-epiglottidean folds, the caustic effect can, of course, be localized much more exactly and to a smaller surface.

This energetic local treatment may be repeated as often as once a week or fortnight, according to circumstances.

The nitrate of silver solutions, which it is well to keep pre-pared of various strengths (16, 24, 48, 96, 240 grains to the

ounce), I apply by means of a well-made thick brush, or with a small piece of soft sponge fastened to a slender metallic rod, which can be screwed on to a bent handle made of strong wire.

I usually prefer the brush, because with the strong solutions which I employ I in this way avoid introducing too much fluid, and succeed better in making a uniform application to the interior of the larynx. These objects can be more easily accomplished by a very thick brush with a good point than by the sponges so strongly recommended by Tobold. Still, it cannot be denied that the latter are useful in the application of weak solutions.

Among the other astringents strong solutions of *tannin* and *alum* are also worthy of mention, but their effect is less certain and pleasant than that of nitrate of silver. In cases of long standing the *tincture of iodine* may also be tried, at first diluted, or the *iodine in glycerine* (Lewin).

The injection of astringent remedies by means of a small syringe is generally unadvisable, because the fluid easily runs down into the trachea, even if injected during phonation.

The application of astringents in a powdered form is likewise objectionable, because its operation is uncertain and disagreeable to the patient.

Now and then during the course of the astringent treatment intervals should be allowed, during which inhalations of bromide of potassium or chlorate of potassa solutions are to be used. In plethoric persons saline cathartics, such as the Ofen bitter-water or the Carlsbad Sprudel salts, may be taken every morning fasting. If at the same time the diet be regulated by limiting the amount of food, especially in regard to nitrogenous articles, and if spirituous liquors be entirely proscribed, quite a rapid improvement may usually be effected even in the very old chronic catarrhs of plethoric and hemorrhoidal patients, particularly if energetic local treatment with nitrate of silver or tincture of iodine be used at the same time.

The removal of the remaining infiltration and the hyperplastic thickening presents great difficulties, and all the more because the endurance of the patient is apt to become exhausted as soon as he notices any considerable improvement.

In these cases I have seen much benefit from the employment of the electrical current in both forms, applied percutaneously

as well as to the pharynx. This treatment is adapted not only to relieve the secondary muscular pareses, which are so common, but also to remove the exudation and hyperæmia.

External counter-irritation to the neck by means of blisters, tartar-emetic ointment, and croton oil, as was formerly the general practice, has more and more gone out of use since the introduction of laryngoscopical local treatment. Priessnitz's compresses, however, and the application of tincture of iodine and strong iodine ointment to the skin of the neck, justly retain a certain amount of confidence.

Little is to be hoped for from *baths* and *the use of mineral waters* when they are employed alone without proper local treatment. The patient generally finds himself much better during the course of this method of cure, in fact, often quite free from his complaint ; but as soon as he returns to his usual habits of life, and is again exposed to the former injurious influences, the catarrh soon resumes its former intensity.

These remedies are, however, very valuable when used in connection with a rational local and dietetic treatment, and whenever it becomes necessary to intermit the local treatment for a time, for the sake of rest to the larynx, they are a very good temporary substitute.

The *cold sulphur springs* of Weilbach, Nenndorf, Eilsen, etc., have long enjoyed a reputation in the chronic catarrhs of plethoric and hemorrhoidal patients, and no doubt many of these cases, in which a torpid chronic catarrh is associated with the so-called hemorrhoidal and other abdominal derangements, are much improved by such a course of treatment. Unfortunately we have at present almost no accurate knowledge of the effects of the sulphur waters, and consequently their prescription must be entirely empirical.

The stronger *Glauber's salt waters*, especially the Kreuz-brunnen in Marienbad, and the cooler springs in Carlsbad, act very favorably in the chronic catarrhs of plethoric persons, who are capable of but little physical exertion although they take an abundance of food, and who, from lack of exercise, etc., usually suffer from all sorts of abdominal complaints, such as dyspepsia, constipation, etc.

The warm *soda and chloride of sodium springs* of Ems, and the *salt-water springs* of Reichenhall, Ischl, etc., are better adapted to delicate constitutions with great irritability of the respiratory mucous membrane, and where there seems to be a predisposition to phthisis either from hereditary causes or from antecedent scrofula.

CROUP.

STEINER.

CROUP—LARYNGITIS CROUPOSA ET DIPHTHERITICA.

Descriptions of a disease similar to the laryngeal croup of the present day are to be found even in the works of *Hippocrates, Celsus, Galen,* and *C. Aurelianus.*— *Montanus,* Consultat. med. Venitiis, 1859, Curt. II., p. 51.—*Baillau* in 1576 described croup, and even at that time insisted upon the formation of a pseudo-membrane.—*Villa Real,* De signis, causis, essentia, prognostica et curatione morbi suffocantis. Compluti, 1611.—*Fontecha,* Disput. med. supra ea, quæ Hippocrates, Galenus, Avicenna, etc., de anginarum naturis etc., scripsere, et circa affectionem vocatam Garotillo. Compluti, 1611.—*Ch. Bennet,* Theatr. tabid. London, 1656, noticed the expectoration of membranes.—*Nic. Tulpius,* Observat. med. Amstelod., 1685.—*Harris,* 1691.—*Martin Ghisi,* Lettere med., Tom. II. Cremona, 1749.—*Malouine,* Histoire de maladies epidemiques 1747-1751.—*Starr,* An Account of Morbus Strangulatorius, in Philosoph. Transact., Vol. 46. London, 1752.—*Langhans,* Beschreibung verschiedener Merkwürdig-keiten des Siementhales nebst genauerem Berichte über eine neue ansteckende Krankheit. Zürich, 1753.—*van Bergen,* Nova acta naturae curios. Lipsiæ, 1764.—*Francis Home,* An Inquiry into the Nature, Cause, and Cure of the Croup. Edinb., 1765.—*Samuel Bard,* Transactions of the American Philosoph. Society. Philadelphia, 1771.—*Heinrich Callisen,* Acta societ. med. Havniensis, 1778.—*Michaelis,* De angina polyposa. Göttingen, 1778. This author first describes croup and angina gangrenosa as two distinct diseases.—*Johnstone,* Of the Malignant Angina. Worcest., 1779.—*Lentin,* Hufeland's Jour., 1796. —*Märker,* Geschichte einer epidemischen Bräune, in Hufel, Bd. XIX.— *Vieusseux,* Observations sur le croup. Paris, 1806.—*J. H. T. Autenrieth,* Versuche für die praktische Heilkunde aus der klin. Anstalt von Tübingen, 1807.—*Caron,* Traité du croup aigu. Paris, 1808.—*Des Essartz,* Mem. s. l. croup. Paris, 1808.—*Friedländer,* Sammlungen und Beobachtungen die häutige Bräune betreffend. Tübingen, 1808.—*Cheyne,* The Pathol. of the Membrane of the Larynx and Bronch. Edinb., 1809.—*Sachse,* Das wissenswerthe über die häutige Bräune. Lübeck, 1810.—*Löbenstein-Löbe,* Erkenntniss und Heilung der häutigen Bräune. Bamberg, 1810.—*Royer-Collard,* Rapport sur les ouvrages de concours. Paris, 1812.—*Goelis,* Tract. de rite cognosc. et san. angina memb. Viennæ, 1831.—*Senff,* Ueber die Wir-kung der Schwefelleber in der häutigen Bräune. Leipzig, 1813.—*Albers,* Comm. de tracheit. inf. vulgo Croup vocat. Lipsiæ, 1816.—*Jurine,* Abhand-lung über den Croup. Leipzig, 1816.—*Lobstein,* Observat. et recherches sur le

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General Considerations and Etiology.

Croupous laryngitis is that form of inflammation of the larynx in which a fibrinous, yellow-white exudation takes place upon the mucous surface in the form of membranous coagula, which are loosely attached, are readily and frequently regenerated, produce no loss of substance, and leave behind no cicatrices.

The word croup is of English-Scotch origin. It was first used by Vatrick Blair, in 1713, and originally signified strangulation. Cook derives the name croup from the white membrane, which occurs on the tongue of young fowls, and which we call the pip.

As laryngeal croup is frequently associated with croupous inflammation of the mucous membrane of the throat, it has also been called, although incorrectly, membranous, or pseudo-membranous angina.

In diphtheria the lesion is similar to that of croup, only with this difference, that in croup the exudation takes place *upon* the free surface of the mucous membrane, while in diphtheria it occurs at the same time *within* the tissue, and thus produces necrosis and loss of substance of the mucous membrane.

The attempt to distinguish croup and diphtheria as two entirely distinct diseases has been unsuccessful, both from an anatomical and from a clinical standpoint; indeed there are many good reasons for supposing that these two affections are only varieties.and modifications of one and the same process, which, in consequence of special influences and collateral causes, as yet imperfectly understood, makes its appearance at one time

as croup, at another as diphtheria, now in a sporadic form, now as a wide-spread epidemic, now as a primary, and now, again, as a secondary affection.

Every one who has observed many cases of croup and diphtheria must admit that these two affections often occur together, or successively, in the same person; that the throat not infrequently presents the signs of typical diphtheria at the same time that true croup is found upon the mucosa of the larynx and lower air-passages; that in the larynx itself croup and diphtheria are observed to shade into each other; and that, finally, constitutional symptoms, fever, glandular enlargements, and albuminuria are met with during the course of croup, as well as in diphtheria.

Notwithstanding these points of contact the relationship between the two affections is far from being satisfactorily elucidated, and yet it is necessary that their connection should be premised here, because the diphtheritic throat affection is an important factor in the etiology of croup.

Croup may be divided into a *primary*, or *idiopathic*, and a *secondary*, or *symptomatic form*.

The *primary* or *true* croup of the larynx is, especially, a disease of childhood, and is rarely seen in adults. It generally occurs in children between two and seven years of age, much less frequently in newly born infants and nurslings, and very rarely in children over seven years of age.

Among 501 deaths from croup in Vienna, during 1868, 92 were in the first year (30 were 12 months old, and 12 were 11 months), 128 in the second, 87 in the third, 71 in the fourth, 50 in the fifth, 34 in the sixth, 17 in the seventh, 7 in the eighth, 6 in the ninth, 2 in the tenth and eleventh respectively, 3 in the twelfth, 1 in the thirteenth, and 1 in the sixty-second. Among the Christian population, the mortality was 2.6 per cent. Among the Israelitish, 4.2 per cent. (Glatter)

This preponderance of the disease among the Israelites accords with my own experience in Prague.

The *male sex* is more frequently affected than the female; in my own cases, out of 101 children, 77 were boys and only 24 girls. In Bohn's 70 cases, 43 were boys and 27 were girls. Ruehle gives the proportion of boys to girls as 3 to 2.

Strong, well fed, hearty children are no more liable to croup than those who are feeble, delicate, or affected with other diseases. To be sure, croup does occur among rachitic, scrofulous, tuberculous, and hydrocephalic children, but there is no evidence that scrofula specially predisposes to it.

Notwithstanding the views of some writers to the contrary, it must be admitted that there is a *certain hereditary and family disposition* to croupous inflammation in general, and to laryngeal croup in particular. In some families membranous croup is comparatively frequent, while in others it is unknown. I have quite recently become acquainted with two unfortunate families, in one of which all four, and in the other all three children died of membranous croup, within five years in the one case, and within four years in the other. There is no reason to suppose that this hereditary predisposition is specially noticeable in children whose parents have been subject to tonsillar enlargements, or that it originates in scrofula.

This individual predisposition appears to be weakened by the occurrence of one attack, and in my experience of more than 100,000 cases of disease among children, I have never yet met with a single recurrence of true croup. In the literature of this disease only a few instances of this kind are recorded. Guersant states that he has opened the windpipe twice for two attacks of croup in the same child. All reports of the disease recurring three, five, and ten times are fabulous, and refer only to pseudocroup, which we all know usually attacks a child frequently. Even Hönerkopf says that his own child, three years of age, had seven (!) attacks of croup within a year and nine months. Numerous mistakes of this kind have crept into the literature of croup, and only show that the distinction between croup and pseudo-croup is still unrecognized even by many physicians.

Notwithstanding the obscurity which, it must be admitted, still surrounds the etiology of croup, it has been proved that the occurrence of the disease is favored by certain conditions, such as the *season of the year, the weather,* and the *nature of the soil.*

Croup is observed during every season of the year, and at temperatures from 90° above to 31° below zero F. It has been

found to be most prevalent during *moist, cold, changeable weather*, and in many cases the attack seems to be immediately due to *exposure* to *sudden changes of temperature* or to *cutting north* and *north-east winds*.

According to general experience more cases of croup occur in January, February, March, April, October, November, and December, than in May, June, July, August, and September.

Out of 467 epidemics of croup, collected by A. Hirsch, 159 belonged to winter (December 56, January 48, February 33); 130 to spring (March 51, April 42, May 37); 72 to summer (June 21, July 23, August 38); and 106 to autumn (September 22, October 41, November 42).

Croup extends over the whole earth, but strikingly diminishes in frequency, according to A. Hirsch, as we pass from the higher latitudes to the tropics. The same writer says that the disease prevails especially in a moist, cold climate, in narrow valleys swept by cutting winds, on plains exposed to cold winds, and in localities where the temperatures are low, or violent changes occur. The deleterious influence of moisture is shown by Crawford's observation, that in Scotland croup, which had hitherto been a common disease, became rarer after the drying of marshy districts (Pauli).

Primary croup occurs sometimes *sporadically*, sometimes, though less frequently, as an *epidemic*. When several children in a family, or a large number in a neighborhood, are affected with the disease, most of such instances belong generally to the epidemic form; but this distinction has not been sufficiently observed in the literature of croup to make it available for statistical purposes.

Primary true croup is *not a contagious disease*, although it is so regarded by Bohn, Gerhardt, and others. Diphtheritic croup, however, possesses this quality in a marked degree.

By *secondary* or *symptomatic croup* is meant that form which occurs in the course of acute infective or general constitutional diseases, pyæmic processes and other acute or chronic affections. Of the acute exanthemata, *measles* is the one most frequently complicated with laryngeal croup. This complication generally occurs during the stage of desquamation, more rarely during the

height of the eruption, and in very exceptional instances simultaneously with the outset of the measles ; while, on the other hand, pseudo-croup during measles usually occurs as a prodromal symptom. *Scarlatina*, especially when complicated with throat-diphtheria, also manifests a predilection for croup ; the same thing is true of *small-pox*, but less frequently. Another secondary form of croup, and one which is justly to be feared, is that which often accompanies *epidemic diphtheria*. Secondary croup has also been observed during the height of whooping-cough (Vauthier, Steiner, twice), in epithelioma laryngis (Steiner), and in the course of typhoid fever, pneumonia (Blache, West), and cholera.

Symptoms and Course.

In the great majority of cases, but *not always*, as some writers suppose, the disease begins with slight catarrhal symptoms, which have been improperly regarded as prodromal. The child becomes fretful, appears uneasy, sleeps more restlessly than usual, loses his appetite, asks frequently for water, sneezes one or more times at intervals without there being any discharge from the nose, complains of burning and itching in the throat, talks with a somewhat husky voice, and even now his cough has occasionally a shrill tone. These symptoms, which are usually accompanied by a slight fever, gradually become more marked, and if the throat be now examined—as it *always* should be on the first occurrence of suspicious laryngeal symptoms—there shall be found in the fauces either more or less congestion and enlargement of the tonsils, or signs of exudation, although the child may not have complained of any pain or difficulty in swallowing.

The exudation in the throat consists at first of small, circumscribed, grayish-yellow spots, which are generally isolated, upon the tonsils, uvula, soft palate, and posterior wall of the pharynx. These spots gradually unite to form a more extensive patch of exudation, and in severe cases it may happen, as I have seen, that not only the fauces, but also the hard palate, the tongue, and the mucous membrane of the cheeks are covered with a croupous membrane. When the pharynx is severely affected, the submaxillary glands may often even now be found to be enlarged.

Even in this stage of the disease, when the child is still able to go about, and manifests at times his usual sprightliness and love of play, the husky voice, the shrill cough, and the presence of croupous patches in the throat will reveal to the experienced physician the full significance of the perilous nature of the disease.

These initial symptoms, which may in some respects be called the *first stage* of the disease, last from twenty-four to thirty-six hours, or even from two to five days, before the characteristic attack of croup is developed. Laryngeal croup does not, however, always begin with these symptoms, which are entirely similar to those of acute laryngeal catarrh, and are anatomically due to a relaxation and tumefaction of the vocal cords ; in rare cases it happens that the croup *occurs suddenly*, and from the outset assumes its severe form. This form usually occurs late in the evening or near midnight (between ten and twelve o'clock) ; the child, who has gone to bed apparently perfectly well, wakes up suddenly after two or three hours of quiet sleep, crying or coughing with a shrill, hoarse voice, and, in very rapid and intense cases, completely aphonic. Almost always his manner is excited and anxious, the skin hot to the touch, and pulse accelerated.

As soon as this period of the disease is reached—whether the development of the attack have been gradual, or sudden, as in the fulminant form—there is now superadded a new and highly characteristic symptom, *laryngeal stenosis*, with its most important sign *dyspnœa*. With this event begins the *second stage*.

The hoarseness increases and becomes *permanent*. The cough, which is at first shrill and short, becomes barking, and after a while completely toneless. When the patient cries loudly, or has a violent fit of coughing there is still heard, however, a hoarse barking sound, which now and then changes from a bass to a high falsetto note. The respirations are more frequent, between twenty-eight and thirty-two to the minute, rarely more ; the respiratory movements are labored, and effected only by the aid of all the accessory muscles, so that the child, tormented by the *besoin de respirer*, suddenly sits up in bed, straightens his spinal

column, throws his head backwards, and, in short, does, instinctively, all that he can to expand his chest. As the stenosis increases the inspirations become still more laborious and heaving; the child breathes with open mouth; the alæ nasi rise and sink violently; the nasal apertures are broadened, in consequence of the contraction of the musculi levatores alæ nasi; the scapulæ and upper ribs are forcibly elevated; the larynx sinks far down with each inspiration, and the xiphoid appendix and the cartilages of the lower ribs are drawn inwards, and form a deep furrow between the chest and the abdomen.

Notwithstanding this labored breathing, which requires the aid of all the accessory muscles, only a little air forces its way through the narrowed glottis; the *inspirations* are *prolonged*, rather *shuffling* in character, and, in consequence of the powerful suction of the air through the narrowed glottis, accompanied by a *whistling*, *sawing*, or *snoring* sound, which not infrequently can be clearly heard at some distance, and is a most distressing alarm-signal to the parents and physician. In very severe cases, and under certain circumstances to be mentioned presently, the *expiration*, as well as the inspiration, is accentuated or accompanied by a loud rattle. While the inspiratory sound is chiefly of a sawing character, the expiratory more frequently has a snoring quality.

From time to time, and at intervals which become shorter as the case progresses, the dyspnœa, which has been permanent since the occurrence of exudation on the laryngeal mucous membrane, presents exacerbations—the *suffocative attacks*. A distressing restlessness seizes the poor child; lying or sitting in bed he impetuously begs to be taken in the arms of his mother or nurse, and then immediately to be put back into bed again; he tosses his hands and feet about; springs up in the bed, or convulsively grasps the side of his crib; frequently clutches his neck, as if to remove the obstacle to his breathing, and throws off the bed-clothes; the face expresses great anxiety, and not infrequently is even distorted; the eyes protrude; the frontal veins are swollen, and the respiratory muscles taxed to their utmost capacity—in a word, we have before us the heartrending picture of a child nearly suffocated, tortured with the death-

pang ; a picture which draws out all our compassion, and brings home to us, as few other diseases do, the painful side of our calling.

These suffocative attacks sometimes last only a few minutes, at other times a quarter of an hour or even more, and usually end in the child's sinking back upon the pillow, and falling into a short, gentle slumber.

If now we seek for a satisfactory explanation of these symptoms, we shall find that the views hitherto prevalent are by no means harmonious, but in many cases are glaringly opposed to pathological and physiological facts.

According to Schlautmann and Niemeyer, the dyspnœa in croup is caused and kept up, not only by the narrowing of the glottis from swelling and pseudo-membranous deposit, but also and mainly by the *paralysis of the laryngeal muscles.* Universally, says Niemeyer, when we have to do with a severe inflammation of mucous or serous membranes, we find not only the submucous and subserous cellular tissue, but also the muscles covered by the inflamed membranes, saturated, infiltrated with serum, and pallid. In croupous inflammations these changes in the muscles produce paralysis, and when the muscles which open the glottis are thus affected, dyspnœa ensues, because the entrance of air is more or less impeded. This theory, continues Niemeyer, is supported by the consideration of the anatomy of the glottis in childhood. In children, the triangular space known as the *pars respiratoria* of Longet, included between the bases of the arytenoid cartilages as they extend forwards and inwards to the vocal processes, is absent; the glottis is in them a rectilinear fissure, and the dyspnœa, when the muscles of the larynx are paralyzed, must therefore be disproportionately greater than in adults, in whom some, if but little, air can at least pass in during respiration through the *pars respiratoria* glottidis. In paralysis of the laryngeal muscles it is only the *inspiration*, however, which is prolonged and laborious ; the expiration is free and easy. According to Niemeyer, therefore, *laborious and whistling inspiration, with gentle expiration, points especially to a paralysis of the laryngeal muscles ;* while *difficulty in both inspiration and expiration indicates*

narrowing of the glottis by false membranes, or an interference with both the entrance and exit of the air.

Other writers advocate an entirely different view, and explain the dyspnœa of croup as a *purely nervous disturbance in the co-ordination of the respiratory movements.* It is supposed by v. Rudnicky [1] that there is in croup a special irritation of the nerves, and that the focus of this excitation may be situated in different parts. According to the reliable investigations of Verson, says Rudnicky, it appears that the branches of the superior laryngeal and recurrent nerves are provided, immediately before they divide into their muscular subdivisions, with numerous ganglionic cells. In the posterior fibrous layer of the trachea he found true ganglia, from which distinct bands of nerve-fibres proceeded to the muscular layer of the organ. Hence it is conceivable that the irritation produced in the peripheral nerves by the exudation extends also to the ganglionic cells, or that the respiratory centres are directly irritated through an altered composition of the blood, or, finally, that both of these causes may act together. Rudnicky, moreover, seeks to break the force of the theory for which Niemeyer contends, by showing that explanations, which, like this one, are based upon a misrepresentation of the normal condition of the glottis in childhood, must be fanciful and altogether groundless, and that some laryngoscopical observations made by himself and others (Munk), by demonstrating the mobility of the vocal cords in croup, have proved the existence of the very opposite condition of things to that upon which Niemeyer supports his paralysis theory.

Bretonneau, Gerhardt, and others, explain the dyspnoic attacks by the difficulty with which the catarrhal secretion of the bronchi is forced through the narrowed glottis, and thereby transfer the explanation once more to a *mechanical cause.*

Finally, Billard and some other writers still adhere to the hypothesis of a *spasm of the glottis.*

I regard the dyspnœa of croup as *the combined result of several causes acting together or in succession.* The most

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[1] Wiener med. Wochenschrift, Nos. 23, 24, 25, 1873.

important of these is undoubtedly the *mechanical* one, viz., the swelling, relaxation, and intense congestion of the mucous membrane of the larynx on the one hand, and the false membranes and muco-purulent secretion on the other. To every one who has had frequent opportunities for observing after death the anatomical changes in the larynx of children, and who considers how little is needed to block up the glottis in such patients, it must appear justifiable to infer an intimate causal connection between the dyspnœa of croup and the changes referred to. But, some one will object that the most marked dyspnœa is observed in children during life, without any croupous membranes being found after death, and that the anatomical changes are out of proportion to the symptoms of stenosis. In more than one hundred cases of fatal croup among children, I have *always* been able to find false membranes in the larynx, though of course more intensely and more widely developed in some cases than in others; but, aside from this fact, it would still be entirely illogical to talk, as Niemeyer does, of a catarrhal œdema and a resultant paralysis of the laryngeal muscles in those cases where no false membranes were found, and where, consequently, no inflammation could have occurred.[1] Indeed, every practitioner is aware that an inflammatory swelling of the mucous membrane, whether accompanied by a croupous exudation or not, presents at the autopsy an appearance entirely different from its appearance during life. Moreover, there is probably no doubt that the suffocative attacks in croup are caused, and kept up, chiefly by the already narrowed glottis being still further obstructed by loosened shreds of membrane, or by masses of muco-pus. But a part of the dyspnœa, at least in many cases, is due also to the false membranes and to accumulations of muco-pus situated in the lower air-passages. In this way, and by the swelling of the mucosa, the respiratory surface is considerably diminished, so as to impede and accelerate the breathing. The correctness of this conclusion is shown by the fact that after tracheotomy the dyspnœa sometimes continues

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[1] "Wo keine Pseudomembranen vorgefunden wurden, somit keine Entzündung vorhanden sein konnte."—*Original Text.*

to be as urgent as before, although the larynx no longer takes part in the respiratory process.

To these purely mechanical causes of the dyspnœa of croup may be added another of subordinate importance—the paralysis of the laryngeal muscles ; at least some laryngoscopical examinations made during the height of the disease favor this view. And yet I cannot agree with Schlautmann and Niemeyer in regarding the dyspnœa as almost exclusively due to this cause.

As regards the hypothesis of a spasm of the glottis—a direct or reflected irritation of the respiratory centres (Rudnicky)—it at least has the advantage of stimulating us to farther investigation of the nature of the dyspnœa of croup.

The *change in the voice* can, of course, be explained only by a more or less *altered vibratility of the vocal cords.* How much of this is due to the swelling and thickening of the vocal cords, and how much to the croupous membranes themselves, it is impossible to decide with certainty ; but we know, however, that the swelling is sufficient by itself to produce the so-called croupy voice, because the same symptom occurs in pseudo-croup.

The same explanation applies also to the *tone of the cough,* which, according to the degree of mobility of the vocal cords, is at first sharp, rough, and dry, later, barking or crowing, and, finally, quite toneless.

In many cases of croup, especially those which do not run a very violent course, *distinct remissions* are noticed during the second stage of the disease ; the dyspnœa decreases, without disappearing entirely ; the voice regains some of its natural quality, or only shows a crowing impurity of tone ; the cough is less distressing, and the general condition of the child is, on the whole, evidently improved. The fever subsides ; the child is able to get a little quiet sleep ; even asks again for food, and manifests an interest in the objects about him. These remissions, which usually, though not regularly, take place during the morning hours, and are welcomed by the parents with the greatest joy and extravagant hopes, are unfortunately in most cases very delusive, and soon give place to the former, if not to a still more severe dyspnœa.

Now and then the remissions occur coincidently with the discharge, by coughing or vomiting, of false membranes mixed with masses of muco-pus, and then the breathing for a time becomes freer. The portions of membrane discharged consist either of irregular shreds of variable size, thickness, and consistence, or of tubular casts of the parts, according to the locality from which they are derived (see *infra*).

Frequently it happens that a piece of membrane of some size becomes partially or wholly detached from the mucous membrane, and is carried by the expiratory current against the under surface of the vocal cord; in this case both the breathing and the sound accompanying it may be suddenly arrested; then, after a few desperate efforts at inspiration, violent coughing sets in, until the membrane is either discharged or is drawn down into the trachea in inspiration. The movements of these loosened pieces of false membrane produce a flapping sound, which may be heard by the stethoscope placed over the larynx or trachea.

In fulminant cases of croup the remissions are entirely absent, and the disease develops so rapidly from the start, with a steady increase of the dyspnœa, that death ensues in from twenty to thirty-six hours.

If the attack runs a *favorable course*, as unfortunately happens but rarely, the suffocative attacks become less frequent and violent; the remissions last longer; the dyspnœa visibly diminishes; the cough becomes softer and loose; the child expectorates a large quantity of muco-pus mixed with coagulated flakes and shreds; the aphonia or hoarseness is replaced by a slight huskiness, and afterwards by a louder tone to the voice; the face wears a quieter expression; the fever ceases; the skin becomes soft and moist; sneezing occurs more frequently, and the nasal mucous membrane, which has hitherto been dry, now begins to discharge; in short, we have the picture of a laryngeal catarrh gradually progressing to recovery.

In the great majority of cases, however, the patient becomes steadily worse, and another group of symptoms is developed, which forms the *third stage*, or *stage of asphyxia*.

To the signs of laryngeal stenosis are now superadded those of

carbonic-acid poisoning. The hitherto flushed face and the skin of the child become blanched, pallid, and of an earthy color, afterwards bluish-gray and bluish; the anxious and agitated physiognomy becomes indifferent and dull; the eye is drowsy, languid, and generally half closed; the lips, cheeks, and visible mucous membranes become slightly cyanotic; the dyspnœa probably still continues, but the respiratory movements are superficial, and no longer accompanied by the loud stridor; now and then, however, the child still springs up in a desperate struggle for breath, but only to quickly sink back again exhausted into his former comatose condition; the pulse loses in volume, and becomes very rapid and intermittent; the cutaneous veins of the extremities become dilated; the forehead is covered with a cold clammy sweat; the extremities grow cold; the skin loses its sensibility; the consciousness is obtunded, and convulsive movements, or, as I have often seen, carpo-pedal spasms and trismus occur; in short, *both the mental and bodily power of resistance against the deadly disease is broken*, and death, if the patient have survived the danger of suffocation, takes place with the symptoms of complete exhaustion.

That this train of symptoms is due chiefly to *the overloading of the blood with carbonic acid*, in consequence of the impediment, and finally, almost complete obstruction, to the admission of air, is amply proved by the previous explanation of the mechanism of croup. Bartels has found in the expired air as much as 3.27 per cent. of carbonic acid. For a long time it was supposed that the cerebral symptoms at least ought to be ascribed to an engorgement of the cerebral and meningeal vessels; but to this view Niemeyer has opposed the consideration that when the air is prevented from entering the glottis, the suction-force of the lungs, which draws the blood from the veins outside the chest into those within it, becomes increased on each deep inspiration, so as to diminish rather than to increase the amount of blood in the brain.

That this condition of the circulation does not, however, obtain towards the end of the disease, is shown by the fact that at the autopsy the meningeal and cerebral vessels are very generally found distended with blood. The striking paleness of

the skin, however, may be due to the aspiration of blood into the intra-thoracic veins.

As regards the *febrile movement*, it may be said in general that the number of accurate registrations is yet too small to establish any definite laws, and that the curves of the temperature and pulse present different appearances according as the disease runs a rapid or a protracted course. Thus we find cases in which the temperature during the whole course of the disease scarcely reaches or exceeds 101.3° F.; and again others, with a violent onset, where the temperature is as high as from 104° to 105.8°. The latter elevation is common, if the case be complicated with extensive bronchitis or pneumonia. Should the inflammation of the respiratory mucous membrane advance slowly, and with clearly marked aggravations, the fever curve will present corresponding irregularities.

The highest temperature usually occurs in the second and at the beginning of the third stage, but exceptions to this rule, it should be remembered, are frequently met with where complications or an extension of the disease occur.

The *pulse* at the outset of the disease is moderately accelerated (between 120 and 130), and at the same time full and hard. During the second stage it maintains this frequency, but often rises twenty or thirty beats on the occurrence of aggravations, and during the remissions falls by as many beats or even more. In rare cases only is the pulse retarded. In the stage of asphyxia it is always very rapid (from 140 to 160 or even 180), and at the same time small, very compressible and intermittent. Any considerable extension of the membrane to the bronchi, or the intercurrence of croupous pneumonia, is sure to increase the frequency of the pulse.

Among the other symptoms, which are of greater or less frequency in croup, should be mentioned the *enlargement of the submaxillary and lateral cervical glands*, a sign which is always found when the pharynx is implicated in the croupous-diphtheritic deposit. Albuminuria is also noticed, more frequently in diphtheritic, but also in true croup.

Digestive derangements are uncommon, if we except the diarrhœa which is occasioned by the still frequent use of tartar-

ized antimony as an emetic, and which in many children sets in even after the first doses, and often continues until death.

Croup of the stomach, which I have sometimes seen as a complication, produces repeated vomiting, and severe colicky pains, but when emetics are used it is difficult to say how much this symptom is to be reckoned to their account.

Choleraic gastro-enteritis, which, in my experience, occasionally complicates croup, gives rise to the symptoms characteristic of this affection, such as vomiting and repeated flatulent, watery evacuations from the bowels.

Another symptom, which should probably also be regarded as an effect of carbonic-acid poisoning, is the *paralysis of the vagus nerve*, in consequence of which even the strongest emetics fail, during the latter part of the disease, to produce any effect, or only very slight vomiting ; while, immediately after tracheotomy, when the air enters more freely, and the blood is rid of its excess of carbonic acid, repeated vomiting occurs as a result of the emetics still retained in the stomach.

In regard to the presence or absence of *special pain in the region of the larynx*, opinions differ. If I can trust the statements of some of the older children, the croupous inflammation in the larynx does produce a *stabbing, squeezing pain*, which occurs spontaneously, but is felt more particularly when the larynx is touched or compressed.

The *laryngoscopical examination* in children with croup is very difficult, especially when the throat is also affected, and in the majority of cases, particularly if the child be quite young, almost impossible. The difficulty arises chiefly from the stenosis and the great restlessness of the patient.

Münch gives us a minute description of his laryngoscopical examination of a boy ten years of age. The mucous membrane of the larynx was much reddened ; a marked membranous deposit covered the ary-epiglottidean ligaments, and still more copiously the vocal cords; the glottis was narrowed, partly by the deposit upon the vocal cords, and partly by the paresis of the dilator muscles—the posterior crico-arytenoid. Later the whole larynx appeared to be covered with membrane ; at the same time it was noticed that the edges of the vocal cords were apparently agglutinated to each other at various points by a layer of fluid exudation. Subsequently the deposit disappeared under the continued use of caustics, but was

renewed daily, until finally only a thin, gauzy layer of membrane was noticed, which returned again and again with great obstinacy, especially upon the vocal cords. The vocal cords ultimately resumed their function, and manifested considerable vibratility, even while some of the membrane remained. By the sixteenth or eighteenth day the normal white color of the vocal cords was restored, and here and there a reddish streak was all that could be noticed.

Ziemssen found the entrance to the larynx abnormally reddened, and covered with a layer of exudation, with swelling of the vocal cords, which were coated with a grayish-white substance, and immovable. Anteriorly their borders were in contact, but posteriorly they were separated by a narrow slit, which was broadest at the posterior commissure.

Jaksch, in a boy thirteen years of age, found the vocal cords separated by a distance of four mm.

Similar appearances are recorded also by Türck, Semeleder, Levin, Tobold, Benecke, and R. Förster.

In only a very few cases is the exudation limited to the *larynx*. Usually, as has already been mentioned, and as we shall again insist (see *infra*), pseudo-membranous deposits occur also in the throat and cavity of the mouth. Moreover, the *mucous membrane of the trachea and bronchi* is often implicated in the croupous inflammation, and then we have the laryngeal croup complicated with a tracheo-bronchitis crouposa, which not infrequently extends into the bronchioles, and thus seriously increases the danger to life. When the case runs a rapid course this complication frequently arises quite early in the disease, but in other cases, with a slower progress, not until later; and, when tracheotomy has been performed, I have often satisfied myself that there were no signs of bronchitis until two or three days after the operation.

During the continuance of the stormy manifestations of laryngeal stenosis, the symptoms of bronchial croup are by no means sharply and clearly defined, and, in my opinion, it is impossible to recognize them with certainty at this period.

Some writers—Peter and others—hold that feebleness of the respiratory murmur, urgent dyspnœa, and marked depression of the epigastrium are pathognomonic of bronchial croup, but I have no faith in these signs, at least before tracheotomy. The loud, whistling, sawing sounds in the larynx usually overpower the pulmonary vesicular murmur so completely that the latter

cannot be heard at all, or only feebly ; how could it be other-
wise in view of the small quantity of air, which is only with dif-
ficulty drawn into the lungs ?   After tracheotomy, however, the
case is different.   The larynx is, for the time being, no longer a
part of the respiratory tube ; a new air-passage has been formed,
and now the state of the lungs and bronchi can be determined by
a physical examination.   If, after tracheotomy, the breathing
becomes more difficult and rapid ; if, on auscultation, the vesicu-
lar murmur is feeble and uncertain, and crackling râles are to be
heard here and there, then there can be no doubt that the bron-
chi have taken part in the croupous exudation.   How cautious
one ought to be in diagnosticating this complication, I have often
experienced.   Not infrequently just before tracheotomy I have
found, over a whole lung, very feeble breathing, or at a particu-
lar spot the percussion note evidently shortened, or the breath-
ing uncertain, so that I have been apprehensive of incipient
pneumonia, and yet, after the windpipe was opened, the respira-
tion over that part became loud and clear, and the dulness on
percussion entirely disappeared.   Peter has recorded similar
experiences, and has called attention to this possible source of
error.   Of course the most certain sign of bronchial croup is the
expectoration of false membranes in the form of tubes, varying
in length and thickness, and in rare cases even representing the
branchings of the bronchi.

If the bronchitis is already present when the laryngeal steno-
sis is at its height, the relief afforded by opening the windpipe
will be but slight, and generally only temporary.   When the
bronchial croup does not occur until after the operation, the
symptoms above described may not set in for several hours, or
even days.

Croupous bronchitis is unquestionably more frequent in cer-
tain localities and at certain times than at others; hence the
differences of statistics.

Bronchial catarrh is another almost constant accompaniment
of croupous laryngitis.   Niemeyer says, that " the compara-
tively insignificant results of tracheotomy in protracted croup
are due solely to this complication, whose frequency can easily
be shown to be a *necessary result*.   When the thorax expands,

and the pulmonary alveoli enlarge, without admitting a proportionate quantity of air, the air in the bronchi and alveoli must become rarefied, and must act upon the bronchial mucous membrane and inner wall of the alveoli in the same way as a cupping-glass does upon the skin, producing hyperæmia and increased transudation from the vessels in consequence of the diminished pressure upon the walls of the vessels." In this explanation of the bronchial catarrh in croup—an explanation the force of which cannot be denied—Niemeyer has, it seems to me, laid too little stress upon the inflammatory element, and too much upon the physical cause of the catarrh. I shall refer to this point again in the section on the pathology.

Pneumonia is a much rarer complication of croup than is commonly supposed. Sometimes it occurs in a *lobular*, less frequently, in a *lobar* form. In seventy-two autopsies I found the former variety only eight times, the lobar diffuse pneumonia only six times ; hence I am surprised that some writers regard pneumonia as one of the most frequent complications of croup.

Difficult as is the diagnosis of croupous bronchitis during the height of croup, and especially before the windpipe is opened, the signs of pneumonia are equally uncertain. The lobular form presents no symptoms, either of an objective or of a subjective character, which are at all characteristic, and what symptoms there are, as has already been mentioned, are almost completely masked by the laryngeal stenosis. If the pneumonic infiltration be very extensive, perhaps it may be recognized by more or less dulness on percussion; still even here the experience of Peter and myself shows that mistakes may easily occur. In my own opinion, the physical signs of pneumonia are to be relied upon only when they continue, or are more distinctly pronounced, after tracheotomy. If pneumonia, especially the lobar form, first develops some time after tracheotomy, the usual symptoms are a renewed frequency of the pulse, an elevated temperature, increased dyspnœa up to fifty or sixty respirations per minute, and in older children sometimes a marked initial chill. Some writers have supposed that laryngotomy favors the occurrence of pneumonia, but this supposition is based neither upon theory

nor experience. Pneumonia, like other complications of croup, usually runs quite an acute, and generally an unfavorable course.

The previous remarks in regard to lobular pneumonia will apply almost entirely to the *atelectases*, which are frequently found in children dying of croup. These lesions are most commonly situated in the lower and posterior parts of the lungs, and vary both in number and size. Unless they are of considerable extent, auscultation and percussion are of but little avail for diagnosis.

Pulmonary apoplexy, with pulmonary hemorrhages, and *pulmonary gangrene*, are rarer complications. The latter affection, which I once saw in connection with diffuse pneumonia in a child five years of age, can of course be detected by the characteristic fetor of the breath and expectoration ; but it should be borne in mind that, especially in diphtheritic croup, even the bronchial secretion may be ichorous, and of an offensive odor, without the presence of pulmonary gangrene.

Secondary croup, which develops in the course of various acute and chronic diseases, occasionally presents the same symptoms as the primary affection, but in the great majority of cases its course is milder, and less marked by those severe and stormy disturbances which characterize primary croup. As a rule, the exudation in secondary croup is less copious, and the symptoms of stenosis are but slightly marked or entirely absent ; in fact, I have seen cases in which there were no indications of laryngeal disease during life except more or less hoarseness. The severity of secondary croup seems to diminish also with the age of the patient ; hence the more favorable reports from those whose experience has been with patients of a more mature age. Among children it is not at all uncommon to see secondary croup present the same malignancy as the idiopathic form of the disease. I can recall such cases in my own experience, occurring during the course of measles, scarlet fever, whooping-cough, etc. And yet it must be admitted that when the secondary croup occurs as an expression of a pyæmic process, or during the course of an exhausting chronic disease, it usually assumes a mild form. To state, however, as many text books do, that this

is universally the case, and to compare secondary croup merely with acute laryngeal catarrh, is obviously an error.

The older writers have divided croup, according to its mode of development, into a descending (C. descendens) and an ascending form (C. ascendens). The former include those cases in which the membrane usually begins in the throat, and gradually extends downwards into the larynx, trachea, and bronchi, and in rare instances to the mucous membrane of the œsophagus and stomach. This mode of development is by far the most frequent.

As *ascending croup* were described those cases in which shreds or tubes of false membrane were expectorated or vomited, even before there were any symptoms of laryngitis, the laryngeal affection making its appearance subsequently, and membrane forming finally in the fauces; the inflammation also pursuing the same reverse course from the air-passages to the cavity of the throat.

Cases of this kind have been described by Jurine, Nonet, Hirtz, Salomon, and others, but recently there has been a disposition to doubt or to entirely reject the existence of such a form of croup.

In support of the old opinion I can cite from my own practice four well-marked cases of ascending croup. In each case the disease began with slight febrile symptoms, more or less cough of a painful character, and dyspnœa. After from four to six days, while the voice was still completely sonorous and without any indication whatever of laryngeal obstruction, croupous membranes were expectorated. Towards the end of the first week, and in two of the cases on the fourteenth day—the fever still continuing—hoarseness occurred, followed by laryngeal stenosis in its full intensity, and, shortly before death, by the deposit of false membrane upon the faucial mucous membrane. In each case the disease was ascribed to a severe chill; three died, and one, a girl five years of age, recovered.

Rare as such cases certainly are, their occurrence is unquestionable.

As a rule croup is an *acute* disease, generally terminating within a few days, but occasionally running a more tedious course. In a child five years of age I have seen false membranes upon the mucous membrane of the bronchi even forty-nine days

after tracheotomy. In many very rapid—the so-called fulmi-
nant—cases, the whole course of the disease is not longer than
from thirty-two to forty hours; on an average the attack lasts
from four to six days, but exceptionally as long as even three,
four, or more weeks.

The usual method, and the one adopted in this article, is to
divide the course of the disease into *three stages*. The *first*,
which is also called the *catarrhal* or *prodromal stage*, embraces
the signs of pharyngitis and the early manifestations of disease
on the part of the larynx; it usually lasts from one to three
days, but in the very rare fulminant cases this stage may be
absent. The *second stage* begins with the occurrence of laryn-
geal stenosis, and continues sometimes only one, sometimes
several, and occasionally even fourteen days. The third stage,
or the stage of asphyxia, with its symptoms of carbonic-acid
poisoning, is ordinarily the shortest, and usually lasts only from
thirty-six to forty-eight hours. The duration of the disease is
furthermore influenced by the age of the patient, as has already
been mentioned, by the operation of tracheotomy, and also by
the genius epidemicus.

If the disease terminates favorably, the recovery is generally
complete, and the hoarseness, which sometimes remains, entirely
disappears after a time. In rare instances, however, the case
results in cicatricial narrowing of the larynx, with aphonia and
difficulty in breathing, or—as Schindler and myself found at one
autopsy—in complete occlusion of the cavity. The child was
obliged to wear a canula for more than a year, when death
resulted from the supervention of hydrocephalus. Paralysis of
the vocal cords, continuing for a longer or shorter time, is
another occasional sequel.

For anatomical as well as clinical reasons the conditions in
adults are on the whole much more favorable. The cavity of
the larynx is much wider, while the muscular and cartilaginous
structures are better able to withstand the force of the disease—
considerations which serve to explain in part the superior endur-
ance of adults over children.

In the majority of cases, especially where there has been no
operation, death is caused by general paralysis from carbonic-

acid poisoning ; more rarely by suffocation from complete occlusion of the glottis by a piece of loosened membrane. Among the other causes of death are croupous bronchitis, diffuse catarrh of the air-passages, pneumonia, œdema glottidis, and acute œdema of the lungs. The latter complication is specially to be apprehended when the stenosis is severe, because then the suction-force of the lungs is considerably increased in consequence of the partial exhaustion of the contained air, and pulmonary engorgement is more readily produced. Hemorrhages from ulceration of the trachea or perforation of the innominate artery—accidents which have several times been observed after operations in children—laceration of the air-passages, uræmia, and diphtheritic septicæmia are also occasional causes of death. The greatest mortality occurs during the first five years of life; after this age recovery is far more frequent.

Pathological Anatomy.

The pathologico-anatomical changes which belong to laryngeal croup vary according to the *stage*, *extent*, and *complications* of the disease.

The first alteration at the outset of the disease is a more or less *intense hyperæmia ;* the mucous membrane of the larynx is of a bright red color, swollen, and sometimes dotted with minute ecchymoses, but at the autopsy the hyperæmia may have entirely disappeared, or be scarcely noticeable. Soon after this, along with relaxation and swelling of the submucous cellular tissue, there forms upon the free surface of the mucous membrane an *exudation*, which is sometimes merely a moderately thick *pellicle*, but more frequently a *thin, gauzy,* or a *firm, tenacious false membrane several lines in thickness.* The color is sometimes whitish yellow, at other times gray, brownish, or even blackish yellow, from admixture of blood, etc. Upon the external surface of many membranes may be found here and there red points or streaks of adherent blood. The thinner and softer false membranes are but loosely attached to the mucous membrane and may be easily removed, but those which are firm and solid are more intimately adherent.

It has been repeatedly asserted that in rare instances no

croupous membrane is to be found at the autopsy of children, who have died of croup. The exudation may, it should be remembered, have been present during life in a fluid or coagulated form, but have been expectorated before death; and in general it may be said that the post-mortem lesions in croup present a different appearance at different times, according to the stage of development of the disease, and can be judged of only in connection with the clinical picture.

The croupous exudation, in the form of thinner or thick shreds and flakes, or even casts, sometimes fills up the laryngeal cavity completely, but its favorite situation is upon the vocal cords, which are usually covered uniformly, and sometimes so thickly, by the deposit, that the glottis is narrowed considerably, or even entirely occluded. The ventricles of Morgagni are also more or less coated and obliterated. The external surface of the epiglottis and arytenoid cartilages usually remains free, while on the inner surface traces or larger quantities of croupous exudation are almost always present.

Sooner or later the false membranes become loosened by the exudation of serum on the underlying mucous membrane, after a while separate entirely, and are expectorated in the form of larger or smaller irregular jagged shreds, or of connected membranes or tubes.

After the first membrane is exfoliated a second soon forms, then a third, and so on until death ensues from one of the above-mentioned causes, or recovery takes place from the membranes ceasing to form again, and the epithelium is renewed on all parts of the mucous membrane which had been occupied by the exudation.

Examined *microscopically*, the croupous membrane, which may occasionally be as much as three or four millimetres in thickness, is found to be composed of amorphous or fibrillated fibrine, in which numerous young cells are entangled.

As to its *chemical composition*, the membrane resembles most closely coagulated fibrine, and is soluble in alkalies, and especially in lime-water—a property which has been known for some time, but was never utilized therapeutically until recently by Küchenmeister.

Opinions still differ on some points in the *histology* of the croupous exudation in general and of that of the air-passages in particular. According to E. Wagner—whose numerous and thorough investigations have shown that there is *no sharp divid-ing line between diphtheria and croup*, an opinion with which I must entirely agree—the croupous membrane, as it begins to form, is composed of a thick network of delicate, very fine threads, whose interstices are occupied by numerous bodies essentially like ordinary pus-corpuscles. This network is pro-duced in croup, just as in diphtheria, by a peculiar metamor-phosis of the epithelial cells, which consists in the cells at first becoming enlarged, and then developing long prolongations, by the coalescence of which a network is formed, which acts as a matrix for the newly-formed cells.

In most cases the croupous membrane lies so loosely upon the mucous surface as to be readily detached, being separated from it by a thin layer of muco-purulent fluid, which contains ordinary pus-corpuscles, isolated cylindrical epithelial cells, sometimes ciliated epithelium, and a few blood-corpuscles. Ac-cording to E. Wagner true croup, as well as true diphtheria, may occur on the gums and throat, as well as in the large air-passages ; but most frequently the two diseases seem to shade into each other ; *i.e.*, the affection appears on the gums and throat as diphtheria, in the upper part of the larynx as diph-theritic croup, and in the lower part of the larynx, in the trachea and large bronchi as croup.

In opposition to these views of E. Wagner, F. Steudener regards the croupous membrane as an exudation produced by the migration of numerous white blood-corpuscles from the vessels of the mucous membrane, and the direct formation of fibrine from the transuded blood-plasma. He denies that the epithelium takes any such part in the formation of the matrix of the croupous membrane as was supposed by E. Wagner, and says that he has succeeded in observing the first stages of this kind of transformation in cylindrical epithelium, as Wagner has described it, for the pavement epithelium of the pharynx. An exclusively endogenous origin of the cellular elements of the croupous membrane seems to him improbable ; indeed he is

sceptical whether pus-cells are ever formed in epithelium by endogenous growth.

Boldyrew has also been led by some investigations of his own to reject the epithelial origin of false membranes, and supposes that the latter are produced by the coagulation, in successive layers, of a fibrinous fluid which exudes upon the surface. He calls special attention to the parallel stratification of the membrane so often observed in croup, and to the occurrence of peculiar spherical bodies, presenting a concentric stratification with a cloudy mass at the centre composed of minute granules.

Hallier, Jaden, Laycock, Wade, Oertel, and Klebs believe that they have discovered the nature of the croupous diphtheritic exudation in the generation of fungi. In opposition to this view it is only necessary to say that if vegetable parasites are found upon such exudations, they are probably merely accidental, and are not an essential part of the disease. Karsten [1] has recently very properly again pointed out that the bacteria, vibriones, micrococcus, etc., which are found in the interior of organs during disease or after death, and which are supposed to be the carriers of contagion, are merely *pathological cellular structures* like pus and yeast cells, because one can in fact satisfy himself by careful examination that they originate *within* the cells of animals and vegetables, and do not grow *into* them after the manner of parasites.

The extent of the croupous exudation is modified in various ways by the age and idiosyncrasy of the patient, by the character of the epidemic, and probably also by certain conditions of soil and climate. In the majority of cases of croupous laryngitis the *organs of the throat* are involved in the exudation, and form the starting-point of the inflammation (croup descendens). Occasionally, however, the deposit is entirely absent from the fauces, but in such instances more or less intense redness can always be discovered. The exudation occurs sometimes in the form of true croup, and sometimes in a diphtheritic form, but the wretched confusion and uncertainty which still prevail among physicians in regard to the theory and nomenclature of these two processes, would make it difficult to collect statistics

[1] Wiener med. Wochenschrift, No. 39, 1873.

showing their relative frequency ; moreover, it must be frankly confessed that it is not always easy during life to make a clear diagnosis. Among twenty-one carefully recorded cases, recently under my observation, I found the throat covered with a croup-ous diphtheritic exudation in twenty ; in the other case it was markedly congested.

In laryngeal croup not only the pharynx, but also the *trachea*, and *the large, medium-sized, and small bronchi* are frequently affected in the same way. Thus, in the trachea and larger bronchi we often find firmly coherent, even dendriform tubes, and in the finer bronchi croupous cylinders, or a shreddy, flaky exu-dation. As regards the *structure* of the false membranes in the different parts of the air-passages I can confirm the statement of E. Wagner, that there is no essential difference between them, except that in general, as we proceed downwards, the number of cells becomes greater, and the fine network more scanty and delicate, until finally the croupous bronchitis has changed into a *purulent* or *muco-purulent* one. The implication of the trachea and bronchi is, at least with us, very common ; in fifty-five autopsies of children I found that in thirty-one the croup had extended to the larynx, trachea, and bronchi, with casts even in the smaller tubes ; in nineteen the false membranes were limited to the larynx and trachea, with purulent or muco-purulent secre-tion on the mucous membrane of the bronchi, especially those of the first and second order ; in the other five cases croupous deposits were present only in the throat and larynx, with muco-pus in the trachea and bronchi. It is to be particularly noticed that in *all these cases* false membrane was demonstrated in the laryngeal cavity, and it is safe to say that the absence of exuda-tion, to which some are so ready to appeal, is unquestionably the very rare exception. During an epidemic of croup in Königs-berg, Bohn found in twenty autopsies the trachea affected six-teen times, and the bronchi only thrice. In one hundred and forty-four autopsies Peter observed catarrh forty-four times, croup thirty-two times, and in only eleven an absence of lesions in the bronchi, but in fourteen of the cases no attention was paid to their condition. Bretonneau in thirty-two cases found the air-passages unaffected only once. Rilliet and Barthez state that

the croupous membrane extended as far as the bronchi in only
one-third of their patients.

Houssenot also found the same result in one hundred and
forty-two autopsies. In North America the implication of the
bronchi seems to have been noticed very frequently; while in
England during recent epidemics it has been strikingly rare.

The extension of the croupous exudation to the œsophagus
and stomach is certainly exceptional; I have noticed it only
twice.

The condition of the *lungs* varies; but certain changes, which
are the necessary results of the croup, are almost always ob-
served, more particularly a usually considerable degree of *hyper-
æmia*, and more or less extensive *emphysematous dilatation* of
the lungs resulting from the extraordinary exertions of the
respiratory muscles and the expansion of the thoracic cavity.
The latter condition, as Peter has observed, may even result in
laceration of the pulmonary vesicles, and the production of inter-
lobular and cutaneous emphysema. More or less numerous
atelectases, especially in the posterior inferior portions of the
lungs, are also frequent, either from the plugging of the bronchi
by membranes or by an abundant muco-purulent secretion, or
from paralysis of the respiratory muscles. The development of
such atelectases is particularly favored by the rachitic chest.
Pneumonia occurs sometimes in a *lobar*, sometimes in a *lobular*
form. Its frequency has been variously stated. While I, in the
seventy-two autopsies previously referred to, was able to discover
lobular pneumonia only eight times, the lobar form only six
times, and either form in only about one-fifth of all the cases;
Peter found pneumonia in three-fourths, and Rilliet and Barthez
in five-sixths of their cases. The *bronchial* and *pulmonary
glands* in croup are also, as a rule, in a condition of *hyperæmia*
and *hyperplasia*.

In many cases I have found *pleuritic adhesions*. They have
always been upon the same side as the affected lung, and have
generally been soft and easily detached. In two boys, one three
and a half and the other five and a half years old, I found *ecchy-
mosis* of the *pleura*.

The *heart* is occasionally distinctly *hypertrophied*, and in

rare instances the *muscular substance* has become *fatty*. J. Bridges states that in the majority (!) of his cases he found *endocarditis of the auriculo-ventricular valves*, but this experience must be regarded as unique. Gerhardt and myself have repeatedly seen *acute enlargement of the spleen* not only in diphtheritic but also in true croup. The *kidneys* are either normal, or present the early lesions of *Bright's disease*. I have several times met with *fatty liver*. *Enlargement of the solitary glands in the intestinal canal*, especially in the small intestine, has been observed by R. Maier and myself in all children dying of croup, whether they have been operated on or not. In many cases the *brain* is *much congested;* the meningeal vessels, even to their minutest ramifications, are engorged, and the cut surface of the brain is dotted with numerous points of blood of various sizes ; in three instances I also found *considerable serous effusion* in the ventricles, and once marked *œdema of the brain*.

Diagnosis.

When croupous laryngitis has once become fully established, the diagnosis usually presents no important difficulties. It rests chiefly upon the sudden occurrence of hoarseness or aphonia, the barking cough, the signs of stenosis of the larynx—particularly the constantly increasing dyspnœa—the suffocative attacks, the continuous fever, the enlargement of the submaxillary glands, and—what is most significant in connection with these disturbances—the *discovery of croupous membranes.* While in the throat the presence of these membranes coinciding with hoarseness is a symptom pointing with considerable probability to true croup, their detection in the expectoration and vomited matters may be regarded as an unfailing indication of the disease. In order to be sure of finding the false membranes in the expectoration, it is advisable to examine the sputa in water so as to set the membranes free. The absence of false membrane from the fauces does not always, however, contraindicate the existence of croupous laryngitis, because, as has already been pointed out, the throat may remain unaffected even in true croup.

The most certain diagnosis is, of course, to be obtained by a *laryngoscopical examination ;* but unfortunately this is possible only in a very few cases, and then only in older children. At the height of the disease, and in very young children, even phy-sicians of much experience in laryngoscopy fail to accomplish their object, and Pauli is not far from right when he says, that for the diagnosis of croup the laryngeal mirror is not only inefficient but superfluous.

True croup, especially at its outset, is most readily con-founded with *catarrhal laryngitis*, the so-called *pseudo-croup*. The careful consideration of certain points will clear up any doubt, although in many cases not until the second or third day. Thus in pseudo-croup the morbid symptoms are upon the whole never so intense and continuous as in the genuine form. The fever in false croup is either entirely absent, or only very slight and transient. The tone of the cough may be hard, rough, and barking, but the voice is never so hoarse, or so completely extinct, as in true croup. In pseudo-croup the dyspnœa is never so severe and obstinate, the suffocative attacks are less frequent and weaker, and usually occur at the very *beginning of the disease*, but in true croup not until a later period. Croup-ous membranes in the fauces, and symptoms of permanent stenosis and asphyxia indicate croupous laryngitis, while fre-quent sneezing and coryza, a soft moist cough alternating with shrill, rough tones to the cough, quiet sleep, and gentle inspira-tions unaccompanied by a loud stridor, are symptomatic of laryngeal catarrh.

Experience shows that children who are subject to attacks of hoarseness and barking cough after catching cold, almost never suffer from genuine, but often from false croup. In families where one or more children have already been ill with or have died of true croup, every attack of hoarseness should be regarded with alarm, and as probably indicating true croup. At the beginning of measles or whooping-cough, hoarseness and a barking cough generally signify only a laryngeal catarrh ; but when the same symptoms occur at the height of these diseases, or during convalescence, true croup may often be suspected.

Croup can be confounded with *œdema of the glottis* only

when the individual symptoms are superficially considered. The history of the case, and a careful examination, will always put one on the right track.

The symptoms of *retro-pharyngeal abscess* present a remote resemblance to those of croup, particularly the gradually increasing difficulty in breathing, the great restlessness on lying down, and the snoring respiration. When the abscess is of idiopathic origin it occurs most frequently in nursing children, in whom croup is almost never observed. If the abscess be symptomatic, and dependent upon spinal disease, the latter will decide the diagnosis. Moreover, retro-pharyngeal abscess always develops more insidiously than croup, and without its acute stormy symptoms.

Prognosis.

Croup is, under all circumstances, a deadly disease, and the prognosis is in general extremely doubtful. If certain physicians—generally homœopathists or hydropathists—boast of brilliant cures, while practitioners of known ability and honesty confess to the most dreadful losses, the explanation lies simply in the fact that none but swindlers or ignoramuses indulge in such vaunts. Healthy, robust children succumb just as certainly as the feeble, or as those who are suffering from chronic diseases. Diphtheritic croup is fully as dangerous as the true idiopathic form. The prognosis varies also with the age of the patient, being much more serious in early life, and somewhat more favorable with increasing years. Sporadic cases of croup are generally found to run a less dangerous course than those which occur during an epidemic. If the exudation is confined to the larynx and trachea the prospect of recovery is much better than if the membrane has extended far down into the bronchi. Fulminant cases run a more malignant course than the more gradual cases. Croupous bronchitis and pneumonia seriously increase the danger. A speedily fatal termination is to be expected from the presence of the following symptoms: severe and continued dyspnœa, frequent suffocative attacks, high fever, pallor, and a steel-gray color of the face, impaired consciousness, great fre-

quency and intermittence of the pulse, spontaneous vomiting, and a frequent desire to go to stool. On the other hand, pro longed remissions, the easy separation and expectoration of the false membranes, a steady fall in the pulse, decrease in the dyspnœa, and less shrillness of the cough, with the presence of mucous râles, justify the hope of a favorable termination. If, after tracheotomy, the dyspnœa continues, the child still remains somnolent and feverish, and the canula is dry, a fatal result may be expected; but if the operation be immediately followed by relief to the dyspnœa, and by a disappearance of the symptoms of carbonic-acid poisoning, with a moderately abundant, non-offensive discharge from the canula, the prog nosis is more favorable. The proportion of recoveries is stated by all writers of honesty and diagnostic skill as lamentably small. Out of quite a large number of cases occurring in my practice, *before I had adopted the operation of tracheotomy*, I saw but three recoveries; since 1863, however, this discouraging rate has been so much improved by the employment of trache otomy that the mortality has at different times amounted only to sixty, sixty-five, and seventy per cent. Bricheteau states it at sixty-nine, Franque at sixty-eight, Trousseau at fifty, and Greve in Sweden at twenty-three per cent.

Treatment.

In view of the general facts—which seem to be now well established—that many families exhibit either a hereditary or an acquired predisposition to croup; that the disease is favored by certain conditions of weather, especially sudden changes of temperature, and by the prevalence of north and north-east winds, and that the diphtheritic form is unquestion ably contagious, it is proper to consider here the importance of *certain prophylactic measures*. When such a predisposition exists the child should be *cautiously* subjected to a process of *hardening*, for which purpose nothing is better than cold ablu tions of the neck and chest, begun early in life and persistently and systematically carried out, together with the use of cold water gargles several times daily. If the clothing be adapted to

the age of the child and to the season, it is unnecessary to be too anxious about exposure to fresh air.

If the family, on the father's or mother's side, have exhibited a tendency to croup, the parents should be admonished of the risk of sending the child out of doors during the prevalence of cold dry winds. When an epidemic of diphtheria is raging, the frequent inspection of the throat should not be neglected, in order to discover the first indications of the disease, and when they have made their appearance the patient should be isolated without delay.

As soon as a *membranous exudation in the throat* is detected it should be treated energetically. If the patient be old enough to know how to use gargles, these may be employed : such as lime-water with equal parts of distilled water, or chlorate of potassa, from twelve to sixteen grains to the ounce for children, and fifty for adults. If the patient be too young, or do not possess the knack of gargling, the above-mentioned fluids may be injected into the throat, or the parts may be touched with lunar caustic. In the case of restless or refractory children the stick caustic is dangerous, and should be replaced by a strong solution (two drachms to the ounce), applied by means of a thick camel's hair-pencil, or a small piece of sponge attached to a whalebone rod. The latter instrument is especially useful, when it is intended to apply the caustic solution as far as the entrance of the larynx or to its interior.

Besides these, other local remedies are recommended, some of which act as caustics, while others are said to affect the solution of the false membranes ; they may be used either for brushing the throat or for inhalation in the form of spray—for example, *chromic acid* (twenty-four grains to the ounce of distilled water) by Lewin, *the tincture of iodine, hydrochloric acid*, by Rilliet and Barthez, *lactic acid* by A. Weber, *sublimed sulphur* by Barbosa, *chloride of iron* (from nine to twelve grains to the ounce of water) and *alcohol* (two parts with one of water). I have tried them all, but have found none so efficacious as the remedies previously mentioned, especially the lime-water.

As far as the *special treatment* of laryngeal croup is concerned, it must unfortunately be admitted that, notwithstanding

the great number of external and internal remedies which have from time to time been used and recommended, we do not at present possess any which directly influence the morbid process and upon which we can rely with full confidence. I hope, therefore, that I shall be permitted, without incurring the charge of ignorance in regard to the literature of the subject, to pass over in silence most of these remedies which have come to us from known and unknown sources. Literature has, to be sure, been inundated with them, but the real object has not in the least been advanced.

To follow the *indications of the disease itself*, let us first consider the *antiphlogistic method*, although no brilliant results can be claimed for it. The *abstraction of blood*, especially *locally by means of leeches*, is even at the present day practised and defended by many. I have never used this mode of treatment in croup, because I cannot satisfy myself that it is possible for bleeding to check or abort the inflammatory process, or to prevent the formation and spread of false membranes ; nor have I ever seen any benefit derived from leeches in those children who were treated in this way without my consent.

In case, however, it be decided to try leeching—which would be excusable only with strong, full-blooded children, but never with the feeble, anæmic, or scrofulous, or with those who have diphtheria—from two to six leeches, according to the age of the child, are to be applied to the manubrium sterni, but never to the laryngeal region, because in the latter locality it is difficult to control the hemorrhage which is apt to occur, and because, moreover, the leech-bites would probably be an annoyance if tracheotomy had to be performed.

Far more entitled to be considered a true antiphlogistic is the *rational use of cold*, preferably in the form of *frequently changed cold compresses about the neck*. These applications should be kept up without interruption, so long as the disease presents the character of an inflammation, or the exudation continues to spread. As soon as the symptoms of carbonic-acid poisoning or depression occur, this treatment should be discontinued. Many writers, especially the professional hydropathists, are not satisfied with the merely local use of cold water,

but employ also the wet-cold sheet until a general perspiration is induced. Cold baths are also recommended (Bartels). In the present hopeless condition of the therapeutics of croup, no objection can be made to this treatment, but no more is to be expected from it than from the local application of cold. It should be mentioned, however, that many families have an unconquerable prejudice against cold water, but—to the praise of the laity be it said—the fear of this mode of treatment is gradually disappearing.

Certain authorities—among whom are some whose opinion is entitled to weight—ascribe to calomel a beneficial action in croup. Even Niemeyer advocates its use in doses of a quarter or half grain every two hours. On this point I agree entirely with Oppolzer, who is not only doubtful of the advantages of the treatment, but even deprecates its use on the ground of its tendency to salivate, to excite profuse diarrhœa, and to increase the exhaustion of the child.

Next to the use of cold water, *emetics* are, under certain circumstances, the most useful. It would be wrong to expect from an emetic anything more than a *mechanical effect ;* it is not a specific, an unfailing panacea in croup ; nor has it any revulsive, diaphoretic, or antiphlogistic influence upon the course of the disease. And yet, when the glottis is occluded or narrowed by false membranes or muco-pus, which cannot be removed by coughing, how often do we see a strong emetic remove the obstruction and produce a relief which is apparent even to the attendants? Emetics are to be used early in the disease, and continued every ten or fifteen minutes until they operate. During remissions they should be discontinued, to be resumed when the dyspnœa again increases. The emetics most used are ipecac, tartar emetic, sulphate of copper, and the sulphate of zinc. Each has its panegyrist. *Tartar emetic* is recommended by Rilliet and Barthez, Bouchut, Ruehle, and others as very reliable, while others reject it on account of its tendency to paralyze the heart and loosen the bowels. The *sulphate of* copper (from two to five grains to the ounce of distilled water) was first recommended by Hoffmann, of Darmstadt, and has been since warmly endorsed by Hufeland, Zimmermann, Canstatt, Scharlau, Höner-

kopf, Trousseau, Niemeyer, and others. I have tried them all,
and found them efficacious, but I usually prefer ipecac in combi-
nation with tartar emetic (a powder containing two grains of
ipecac, one-sixth of a grain of tartar emetic, and five grains of
sugar to be taken every ten minutes). If diarrhœa be present,
or if it follow the administration of this prescription, I select the
sulphate of copper. The emetic—whichever one be chosen—
should be given in large doses, in order to obtain a certain and
rapid effect. In some cases, after emetics administered in water
have failed of their effect, I have seen them act by giving them
in wine. Many physicians, Clemens and others, have recom-
mended the administration of emetics in small doses, at short
intervals, but I cannot approve of this method, because the con-
tinued use of the drug diminishes its effect, and the only result
is to still further exhaust the patient's strength. To relieve the
scruples which many persons entertain, I will add that, notwith-
standing the large and frequently repeated doses of copper and
antimony which I have given, I have never yet seen gastritis
produced. The croupous-diphtheritic gastritis, which occurs in
very rare instances as a complication of croup, has no connec-
tion with the use of emetics.

If diphtheria supervene during the course of croup, antisep-
tics should also be used internally, preferably the chlorate of
potassa in alternation with large doses of quinine.

In accordance with his views as to the nature of membranous
croup, Rudnicky recommends the hypodermic injection of mor-
phine and quinine, with the internal administration of arsenic,
and the painting of the exudation with a solution of the perman-
ganate of potassa ; and it was not until he began to use this
treatment, he says, that he became convinced that true croup
was a curable disease. Far be it from me to condemn this treat-
ment without previous trial, but I must say I am not very
sanguine of its success.

If the treatment by cold water and emetics fail to improve
the condition of the child, if the inflammation continue to
advance, and symptoms of carbonic-acid poisoning occur, which
are unrelieved by emetics, but one resource is left—*tracheotomy.*

This operation is no more curative of croup than are emetics ;

it cannot even arrest the croupous process; its only office is to establish a new provisional air-passage while the danger of death from laryngeal stenosis lasts, and to assist nature in her effort to cure; and no other means fulfil these indications so certainly and so directly.

As to the time when tracheotomy is to be performed, I agree with those writers who urge an *early operation*, and do not defer it until urgent symptoms of carbonic-acid poisoning have manifested themselves. All the indications are in favor of an early operation; in fact, I venture to say that, when properly performed, tracheotomy may be a safeguard against the further spread of the croupous process.

The beginning of the third stage—the so-called stage of asphyxia—is the moment when the operation becomes necessary.

In its performance the opposition of the relatives has usually to be combated, and in too many cases their consent cannot be obtained until the condition of the child has become in the highest degree dangerous.

As regards the *operation itself*—which, when possible, should be done by daylight, and with proper assistance—my own experience has convinced me that the best tracheotome is the knife, aided by the finger, and that the best method of operation is to carefully dissect the individual layers until the trachea is laid bare. While in an early operation great difficulty is often met with from the violent rising and falling of the larynx and windpipe, making it necessary to fix the parts by means of sharp-pointed hooks, the later operation—when the asphyxia is far advanced, and the child is already half unconscious—is generally unattended by this obstacle. Many writers advise that the necessary quiet on the part of the child should be secured by the administration of chloroform, but I must confess it would be difficult to satisfy me of the advisability of this practice.

The apprehension expressed by Roser, Pauli, and others, that secondary pneumonia might readily occur from blood flowing into the opened windpipe, I by no means share.

The *locality* where the windpipe is to be opened must be left to the judgment of the operator.

In general it may be said that in children, especially the younger ones, tracheotomy is to be perferred to laryngotomy; furthermore, that high tracheotomy is rendered difficult by a considerable development of the thyroid gland, and by the numerous plexuses of veins; and, on the other hand, the shortness of the neck in fat children is very unfavorable to the deep operation.

Of almost equal importance with the operation itself, so far as the ultimate success is concerned, is a *proper after-treatment*. During the first few days following the operation it is of urgent importance that the child should have a physician or a well-trained nurse at its bedside; and it is the very difficulty of effecting such an arrangement that makes tracheotomy so much more successful in hospitals—to say nothing of the less expense to the parents.

The after-treatment may be divided into a *dietetical*, a *medical*, and a *surgical* portion. As to the first, it is requisite that the bed-chamber should have an abundance of fresh air; the temperature should be between 64° and 68° F., and in order to keep up a certain degree of moisture in the air it is well to place several vessels filled with water in the room.

The *nourishment* should be adapted to the strength of the patient, the height of the fever, and the appetite. In most cases milk, strong beef-broths, eggs, coffee, light kinds of meat, and wheat bread form an appropriate diet; but if symptoms of exhaustion are present, wine, rum punch, etc., should be given. In general, caution in the selection of the food is unnecessary, and if the patient have an appetite, articles may be allowed which do not strictly belong to the dietary of invalids.

The *medical after-treatment* must be modified by the course of the croupous process; if this be checked by the operation, and no new aggravations occur, all further medication may be omitted. If, however, the fever continue, or increase—as always happens when a croupous bronchitis or a pneumonia sets in—wet cold compresses or sinapisms may be applied to the breast, and digitalis, the tincture of veratrum viride, or quinine given internally. If the expectoration cease, or if the secretion from the air-passages be very profuse, ipecac in connection with

ammoniacal solutions, or benzoin, etc., may be used. If the discharge be offensive, preparations of bark with chlorate of potassa may be given, or the muriated tincture of iron or Bestuscheff's tincture of the same.

As to the *surgical treatment*, it is especially important that as broad a canula should be used as possible, and that it should be cleansed of the false membrane and bronchial secretion, which force their way into it, as often as any obstruction occurs. The amount of secretion from the air-passages is not always equally abundant; a moderate quantity may be regarded as a good sign, but when the discharge is very profuse and at the same time offensive, or when it is entirely absent and the canula is dry, especially during the first few days, the prognosis is more unfavorable. In order to keep the respired air moist it is well to place before the canula a light cravat or sponge wet with water. Should severe reaction occur in the neighborhood of the wound, or the soft parts become infiltrated, the wet cravat, frequently changed, will act as a cold compress. If the edges of the wound have an unhealthy color, or are covered with a diphtheritic deposit, they should be treated with nitrate of silver, or a solution of chlorate of potassa, permanganate of potassa, or carbolic acid.

The *time for removing the canula* depends chiefly upon the rapidity with which the laryngeal inflammation disappears. Sometimes this result takes place by the third or fourth day after the operation; in other cases, however, the canula may have to remain for two or three weeks. I have seen some cases where it had to be worn for ten, twelve, fourteen, and once even fifteen months. This delay in its removal—in some cases it may have to be worn permanently—may be caused by chronic swelling of the laryngeal mucous membrane, by ulcerations resulting in stenosis, or, as Schindler and myself have seen, by complete obliteration of the laryngeal cavity in consequence of adhesions, as well as by paralysis of the glottis.

As far as I know there are, in general, *no contra-indications* to the operation; if nothing more can be accomplished, at least the death of the poor child may be made somewhat easier. It is the universal testimony that the result of the operation is usu-

ally very doubtful in children under two years of age, and some
surgeons, for this reason, refuse to operate at this tender age.
I have myself seen two recoveries in such children.

The proportion of recoveries varies according to the character
of the epidemic, the age of the patients, and the period of the
disease when the operation is performed. In the hospital for
children at Prague, there were thirty recoveries out of one hun-
dred operations. Among the 1,698 cases of tracheotomy col-
lected by Duchek, a favorable result occurred in 428, a propor-
tion of 1 to 3.9 (25.2 per cent.), which is probably the correct
average.

Loiseau and Bouchut have tried *catheterism* of the larynx by
passing a tube through the glottis (tubage de la glotte). This
plan has recently been recommended again by Weinlechner for
the introduction of medicaments into the windpipe, as well as
for the relief of the stenosis ; but judging by the trials thus far
made it cannot and will not take the place of tracheotomy.

If tracheotomy be not permitted by the relatives, the treat-
ment in the last stage of the disease can be only *symptomatic*.
The carbonic-acid poisoning and the gradually developing symp-
toms of paralysis demand the rapid and energetic use of *stimu-
lants*, in the form of cold affusions in a warm bath, mustard
plasters to the breast and calves, frictions with warm vinegar,
and internally wine, camphor, musk, or ammoniacal prepara-
tions. These are all generally useless, and are recommended
only in the absence of anything more efficacious.

DISEASES

TRACHEA AND BRONCHI.

RIEGEL.

TRACHEA AND BRONCHI.

Prefatory Remarks.

WHILE the larynx has to display its activity in two directions —in one as the organ of voice, and in the other as an organ for respiratory purposes—the trachea and bronchi, on the contrary, play a relatively subordinate rôle. Interposed as they are between the larynx and the pulmonary parenchyma, where the interchange of gases is effected, their first and most important function is to serve as conducting-tubes for the passage in and out of the air. The greater calibre of the trachea, in proportion to that of the larynx, is such, that even severe diseases of the trachea often progress without essential disturbance of the mechanism of respiration. On the other hand, however, diseases of the trachea present so many analogies and relations to those of the larynx, that the separation of tracheal and laryngeal diseases is not altogether thoroughly practicable. In the following description, therefore, we will only undertake the special description of those forms which are not in direct association with analogous diseases of the larynx. Many affections of the larynx, however—croup more than all others—are characterized by the frequency with which the trachea participates in the malady. This point must, therefore, have already received proper consideration in the description of the analogous diseases of the larynx; so that a separate description of these diseases, often secondarily extended upon the trachea, appears to be unnecessary.

While the diseases of the larynx, in correspondence with the functional significance of the organ, are sometimes associated with alterations of voice and sometimes with dyspnœa, the

majority of diseases of the trachea and bronchi do not produce
any important disturbance in either of these two directions.
Even in severe grades of tracheal stenosis the voice shows
hardly any important modification. It is somewhat different
with reference to the respiration, which, however, also presents
no important deviations from the normal condition in the more
simple affections of the trachea, so long as they do not produce
any considerable encroachment upon the calibre of the tube. It
is different in the higher grades of diminution of the calibre of
the trachea, no matter by what cause it may have been pro-
duced.

The diameter of the trachea as a connecting-tube bears a
certain reciprocal relation with the size of the respiratory appa-
ratus in general; and the volume of the latter, again, with the
size of the entire body. If the relations between the diameter of
this connecting-tube and the size of the respiratory organ is dis-
turbed, then the admixture of oxygen in the blood must be less
in any given unit of time, and disturbances in the function of
respiration must result in consequence. *Dyspnœa* takes the
first rank among these disturbances. In just that proportion in
which the diminution of the calibre of the trachea becomes
greater in degree, will this dyspnœa undergo increase. Here,
also, as in affections of the larynx associated with stenosis of a
high grade, there is a special form of dyspnœa, which has been
distinguished as "*inspiratory dyspnœa.*" The characteristic
of this special form of dyspnœa lies in the greater impediment
to inspiration, in contrast to the relatively unimpeded expira-
tion, in most instances. Inspiration is remarkably protracted in
the severest grades of this form. It is performed at the greatest
expense of muscular force. The vertebral column is stretched,
and the head bent backwards; in consequence of which inspira-
tion is effected with a loud whizzing or sipping noise, while
expiration follows comparatively easily and noiselessly.

A further peculiarity consists in this: that the respiration is
not accelerated, as one might be disposed to expect; but, on the
contrary, is sometimes even considerably slackened, in a manner
analogous to that which is often enough witnessed in croup.

That form of dyspnœa observed in many bronchial affections

is, on the other hand, less characteristic. We encounter here both that form of dyspnœa which I have designated as "*mixed*," on a previous occasion,[1] and the so called "*expiratory dyspnœa*." The peculiarities of these forms of dyspnœa, and the circumstances by which they are occasioned, will be recurred to in describing the individual diseases.

Cough must be designated as one of the almost constant symptoms of diseases of the trachea and bronchi.

The majority of tracheal and bronchial affections, as is well known, are associated with cough. The intensity of the paroxysms of cough is in no way immediately dependent upon the extent or intensity of the local alterations, nor upon the consistence of the secretions; so that we cannot form any definite conclusions, from the nature and severity of the cough, as to the seat and extent of the pathological alterations.

The great importance of the cough in all affections of the respiratory organs, and especially in those of the trachea and bronchi, renders it desirable to interpolate a short résumé of our present knowledge of the subject, and especially of the most important of the experimental investigations which have been made on that point. The results of experimental inquiries are the more deserving of attention, that clinical observations in this direction have been deficient.

Physiologico-experimental investigations upon the nature of cough were, until recently, tolerably meagre; and it is only quite lately that a few very worthy observations have been published on this subject.

The first exact experiments on cough date from Krimer,[2] whose investigations led him to the conclusion that cough is originally a nervous affection, principally affecting the pair of pneumogastric nerves. On the other hand, as he found by his experiments, irritations of the recurrent nerve did not induce cough. He proved, further, that even when the recurrent nerves of both sides were divided, hoarse cough still occurred, and that

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[1] *Riegel*, Die Athembewegungen; eine Physiologisch-pathologische Studie. Würzburg. 1873. A. Stuber.

[2] Untersuchungen über die nächste Ursache des Hustens, von *Dr. Krimer*, 1819.

even after the further division of both pneumogastrics, pinching
or bruising of the œsophagus still excited cough.

In the second place, the experiments instituted by Budge[1]
are to be taken into consideration.   Budge came to the con-
clusion, from his experiments, that cough occurred primarily
only in the larynx, but not further down ; a conclusion with
which Blumberg's[2] experiments are also in accordance, inas-
much as he also failed to see cough produced by irritating the
tracheal and bronchial mucous membrane.

On the other hand, Longet[3] found cough excited by irritation
of the bronchial mucous membrane ; and Cruveilhier,[4] Rom-
berg,[5] and Budge,[6] excited cough by irritating the pneumogas-
tric nerve.

Then we have to mention the experiments of J. Rosenthal,[7]
who considered the superior laryngeal nerve as the special nerve
of cough ; inasmuch as he observed relaxation of the diaphragm,
with simultaneous constriction of the glottis and spasmodic
contractions of the expiratory muscles ensue on irritating the
inner branch of that nerve.

We are indebted to Nothnagel[8] for an important advance in
our knowledge of cough.   He was the first to prove with cer-
tainty, by actual experiment, that cough can be excited by irri-
tation of the tracheal and bronchial mucous membrane ; and
that not only does the superior laryngeal nerve act as a nerve of
cough, but that there are fibres situated still further backwards
in the pneumogastric nerve whose terminal extremities in the
mucous membrane of the trachea excite the reflex act of cough
when suitably irritated.   Nothnagel was unable to excite cough
by irritation of the pleura, or by irritation of the intact branch,

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[1] *Budge*, Allg. Pathologie, p. 232.

[2] Dorpater Inaugural Dissertation, 1865.

[3] *Longet*, Anatomie u. Physiologie des Nervensystems, T. II., p. 264, 1849.

[4] Nouv. Biblioth. méd., 1828. T. II., p. 172.

[5] Müller's Archiv, 1838, p. 311.

[6] Lehrbuch der Physiologie d. Menschen, von *Dr. Valentin*, 1844, Bd. II., p. 757.
Budge, Untersuchungen über das Nervensystem, Hft. II., p. 75.

[7] *J. Rosenthal*, Die Athembewegungen und ihre Beziehungen zum N. vagus, 1862.

[8] Zur Lehre vom Husten, Virchow's Archiv, Bd. XLIV.

or the central stump, of the pneumogastric or superior laryngeal nerve.

Finally, the very recent and commendable work of Kohts[1] is to be mentioned; from which, by the way, we have extracted the preceding historical remarks. The importance of the subject renders it desirable to present here the most important conclusions of the numerous experiments of Kohts.

While the free borders of the vocal cords were not sensitive to the touch, intense cough set in at once on touching the inter-arytenoid fossa. Irritation of the glosso-epiglottic fold, and of the aryteno-epiglottic fold, also excited cough. On the other hand, Kohts was as little able as Nothnagel had been to determine whether irritation of the alveoli excited cough or not.

In accordance with the results of earlier experimenters, Kohts found, in reference to the cough proceeding from the mucous membrane of the trachea and bronchi, that the cough is most lively on irritation of the bifurcation of the trachea, and less active on irritation of the trachea and bronchi.

Furthermore, he was the first to furnish experimental evidence that cough may also be produced by irritation of the pleura.

Supported by the clinical experience that cough is present in most affections of the pharynx, he instituted a series of experiments which led to the conclusion that, on irritation of the posterior pharyngeal mucous membrane, as well as of the inner surface of the soft palate, one or two succussions of cough ensued as a rule, and continuous cough occurred but seldom. Intense cough ensued both upon mechanical and electrical irritation of the pharyngeal nerve; and the cough following powerful pulling of the nerve amounted to a veritable paroxysm.

Pulling and pinching the œsophagus also succeeded in exciting cough; while, on the other hand, the experimental investigations concerning irritations applied to the stomach always gave negative results.

As far as regards the pneumogastric nerves, the experiments coincided with the results arrived at by earlier authors, viz., that

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[1] Experimentelle Untersuchungen über den Husten. Virchow's Archiv, Bd. LX., Hft. 2, p. 191.

cough ensued upon mechanical and electric irritation of the root of the vagus, as well as of the central stump of the nerve. Exquisite cough likewise resulted from irritation of the root of the superior laryngeal and of the pharyngeal nerve. Irritation of the recurrent nerve, on the contrary, always gave negative results.

Finally, slight pressure upon the rhomboid groove, immediately under the cerebellum, on both sides of the raphe, repeatedly excited cough; and weak electric irritation near the raphe, above the calamus scriptorius, also produced cough on several occasions. It therefore appears certain that there is also a central cough, which may be excited by direct irritation of the medulla oblongata.

It may suffice, in this place, to have alluded briefly to the physiological inquiries arising from these results. In describing the individual forms of tracheal and bronchial affections we will have repeated opportunity to return especially to this point. Here the remark need only be made, that clinical experience also favors the admission that reflex cough may proceed not only from the tracheal mucous membrane, but also from other localities, as the pleura and the like.

The experimentally ascertained fact, also, that the inter-arytenoid incisure is characterized by a peculiar reflex irritability, is in full accord with clinical facts, as can be readily ascertained at any time. The same is true of the irritability of the bronchi. It is to be considered, too, that the experimental facts just narrated were substantiated upon normal mucous membrane, and it is, therefore, readily comprehensible that this reflex irritability may undergo considerable increase in cases of severe inflammation. It appears to be otherwise in many cases of chronic inflammation of the tracheal, and especially of the bronchial mucous membrane, in which the irritability is sometimes so remarkably blunted that even considerable accumulations of secretory products may take place without exciting special cough. It is not to be forgotten, as already advanced by Biermer,[1] that very often the source of the cough in bronchitis does not originate in

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[1] Bronchienkrankheiten, in Virchow's Handbuch der speciellen Pathologie u. Therapie.

the bronchi, or at least not in the bronchi alone, but higher up, in the trachea and in the larynx.

Pain is less frequently observed in the diseases of the trachea and bronchi than cough. When present it is rarely intense, and is chiefly occasioned by the paroxysms of cough. Not infrequently it is manifested rather as a sensation of tickling, or a slight soreness along the trachea and the sternum, or a dull sensation of pressure. Severe pain is not observed in the majority of these affections.

The condition of the *sputa* is exceedingly different in individual cases. There are no authoritative distinctions of such a nature that simple inspection of the sputa will furnish reliable conclusions as to the locality of production. The special relations of the sputa will be mentioned in describing the individual forms of disease.

Precise methods of *physical exploration* are of special importance in the recognition of the diseases of the trachea and bronchi. *Inspection* furnishes no specially prominent indications, if we except exploration with the laryngoscopic mirror, soon to be described. Only in the severer forms of tracheal stenosis are important deviations from the normal type of respiration observed, similar to those which croup of the larynx frequently furnishes opportunity of witnessing. In certain forms of bronchial diseases, however, there are deviations from the normal type and depth of the respirations. The breathing then exhibits the above-mentioned character of expiratory or mixed dyspnœa, on the one hand, and, on the other hand, in addition, certain abnormal changes in the part taken by individual portions of the thorax ; the main burden of the respiratory movements being thrown upon the healthy portions, while the diseased portions participate in breathing in a correspondingly diminished degree. The inspection of known anomalies is of important service in accurately estimating the degree and extent of morbid disturbances.

Exploration with the *laryngoscopic* mirror is of especial importance in the recognition of diseases of the trachea ; but the method, unfortunately, is too little employed for the purpose. And yet it is practicable, with some practice and the observance

of a few precautions, to inspect the entire tracheal tube, as far as the point of bifurcation, with the aid of the laryngoscopic mirror, if not in every case, at least in the greater number of subjects, provided the illumination is sufficiently intense. In the ordinary method of laryngoscopy at most only a greater or smaller portion of the anterior wall of the trachea is inspected. The reason of this is to be found chiefly in the different relations of that portion of the larynx situated above the glottis, and that portion beneath it. The two portions, as is well known, form an angle with each other which is much more obtuse when the head is maintained in the erect posture, than when it is strongly bent backwards. In the majority of persons it is easy to render this angle so much more obtuse that a rectilinear track is secured large enough for the rays of light to pass through the larynx and the entire trachea down to the commencement of the bronchi. A more detailed description of the precautions by which we overcome the obstacles opposed to inspection of the trachea, in individual cases, cannot be entered into here, and the reader is referred, on these points, to the manuals on laryngoscopy, and especially to the excellent manual of Türck.[1]

The significance of tracheoscopy in the recognition of special diseases of the trachea is evident without further explanation. Without direct inspection a great number of tracheal diseases cannot be sharply differentiated from each other, while a glimpse in the mirror suffices at once to learn the nature, locality, and extent of the affection.

Some physiological phenomena, first described by Gerhardt,[2] deserve mention in this place. Gerhardt was the first to direct attention to a normal pulsating point in the tracheal wall. In individuals with chronic catarrh of the respiratory mucous membrane, associated with a copious secretion, cardiac systolic râles, as is well known, are often heard from the opened mouth. In such individuals most distinctly, but in most others also,

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[1] Klinik der Krankheiten des Kehlkopfes und der Luftröhre nebst einer Anleitung zum Gebrauch des Kehlkopfrachenspiegels und zur Localbehandlung der Kehlkopfkrankheiten, von Dr. Türck. Wien, 1866.

[2] Ueber syphilitische Erkrankung der Luftröhre. Deutsches Archiv f. klin. Med., Bd. II., p. 543.

when attention has been once directed to the phenomenon, the lateral walls of the trachea, just above the bifurcation, can be seen to pulsate in the mirror, the pulsation being more strongly marked on the left side. A glance at Luschka's plates shows at once how the trachea, at this point, lies wedged in between the arch of the aorta and the trunk of the innominate artery (Gerhardt).

Quite recently, and, as it appears, independently of Gerhardt, Schrötter,[1] has likewise described this movement of the trachea and primitive bronchi, visible in the laryngoscopic mirror. He has examined a great number of healthy and diseased individuals with reference to this movement of the trachea, and has thereby come to the same conclusion mentioned above, that in very many persons the trachea may be inspected in the laryngoscopic mirror, as far down as to its bifurcation, if only the precautions alluded to are observed, as already laid down by Türck for this purpose.

Schrötter describes the movement of the trachea, just briefly sketched, as a spasmodic pulsating displacement of the bifurcation-spur,—that is to say, of the ridge which projects more or less sharply at the subdivision of the trachea into the two bronchi,—alone or simultaneously with displacement of contiguous portions of the trachea and bronchi.

This movement is especially evident when there are injected vessels coursing over the structures mentioned, presenting a point for observation concerning the nature and extent of the locomotion, the extent often amounting to at least two lines. Out of seventy individuals the manifestation was present in twenty-seven instances, in such a manner that the bifurcation spur, coursing more or less directly from before backwards, was moved backwards from right to left, and exactly in unison with the heart's systole; in twelve cases the movement was directly the opposite; and in seventeen instances the movement was a complicated one, being not simply lateral, but at the same time from before backwards, or the reverse.

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[1] *Schrötter*, Beobachtungen über eine Bewegung der Trachea und der grossen Bronchien mittelst des Kehlkopfspiegels. Aus dem LXVI. Bande d. Sitzb. d. k. k. Akad. d. Wiss , III. Abth. Juliheft. Jahrg. 1872.

Schrötter conceives that the movement from before backwards, and the movement from left to right is produced by the ascending portion of the aorta and its arch ; but at the same time an influence from the descending portion upon the left bronchus from behind cannot be entirely disregarded, because this finds attachment and support on the spinal column.   In the second place, the two branches of the pulmonary artery are also of great importance, and the movement from before backwards may well depend upon the circumstance that the point of division of the trachea and the right bronchus lie immediately behind the right branch of the pulmonary artery ; in like manner, the movement backwards, and that to the left also, may depend upon the fact that the left bronchus lies behind and below the left branch of the pulmonary artery.   In the third place, a combination of the first and second movements may well explain the combined oblique movements.   When we reflect further that the innominate artery and the common carotid of the left side course over the anterior tracheal wall, we can readily see how the pulsations of these vessels may also produce movements of portions of the trachea situated higher up (Schrötter).   Schrötter believes the cause of the individual differences of the movement to reside in the normal limits of the deviations in the course and topographical relations of the organs concerned.

Palpation affords few data, on the whole, for the recognition of diseases of the trachea and bronchi.   The same may be said of *percussion*.   *Auscultation*, on the contrary, is of much greater importance, and constitutes, in diseases of the bronchi especially, the most valuable method of exploration.

On the other hand, again, the results accruing from the use of the *spirometer* and the *tape-measure* are without great significance in the diseases in question.

Stethography,[1] introduced by myself, elicits results in many cases not altogether insignificant.   We will recur to the details of this procedure in treating of special forms of disease.

Pneumatometry,[2] recently introduced by Waldenburg, as a

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[1] Deutsches Archiv f. klin. Medicin, Bd. X., p. 124, and Bd. XI., p. 379.

[2] Die Manometrie der Lungen oder Pneumatometrie als diagnostische Methode. Berliner klinische Wochenschrift, 1871, No. 45.

method of clinical exploration, is also competent to furnish valuable conclusions in many forms of tracheal and bronchial disease.

Before turning from these general remarks to the description of individual forms of disease, we must again premise the remark that in consequence of the intimate relations which diseases of the larynx and trachea, on the one hand, and those of the trachea and bronchi on the other, bear to each other, their frequent concurrence renders their precise separation impracticable in many instances. Many diseases of the larynx are associated with analogous disease of the trachea, while the same disease is not at all confined to the trachea alone, or only in extremely rare cases. In the first class of cases the disease of the trachea is much less significant than its analogue in the larynx. These relations must have been considered already in treating of the diseases of the larynx, and we refer the reader to the appropriate chapter on laryngeal diseases. On the other hand, many tracheal diseases are almost always complicated with analogous diseases of the bronchi, so that here, also, the separate description of both represents only an artificial division. From this point of view the following division of our subject will find its justification.

MALFORMATIONS.

Congenital Diseases of the Larger Air-Passages (Trachea and Bronchi).

C. H. Dzondi, De fistulis tracheæ congenitis. Halle, 1829.—*Ascherson*, De fistulis colli congen. Berlin, 1832.—*Fleischmann*, Bildungshemmungen der Menschen und Thicre, 1833.—*Harless* in Reil's Archiv für die Physiologie, Bd. IV., p. 218.—*Collomb*, Œuvr. med.-chir. Paris, 1798.—*Gilibert*, Sammlung pract. Beobacht., p. 97.—*Klein*, Monstr. quorund. descriptio. Stuttgart, p. 23.— *Blanchot*, Acta nat. curiosa an. IX., p. 350.—*Otto*, Monstror. acephal. descriptio. Francofurt:, 1808.—*The same author*, Seltene Beobachtungen zur Anatomie u. Physiologie, 1816, Hft. 1.—*Brodie*, Journ. de médec. Paris, 1810, Octobre, p. 281.— *W. Horn's* Reise, Berliner medic. Zeitung, Jahrg. 1, No. X., p. 160.—*Fleischmann*, De chondrogen. asperæ arteriæ et situ œsophagi abnormi nonnulla. Erlangen, 1820.—*Schöller*, Eigenthümliche Missbildung. der Speiseröhre als Ursache einer Verbindung des Athmungsapparates mit dem Verdauungskanale, Neue Zeitschrift f. Geburtskunde von Busch, d'Outrepont und Rittgen, Bd. VI., pp. 264–273, 1838.—*Meyer*, Rust's Magazin, Bd. 55, Hft. 1. Casper's Wochenschrift, 1873, No. 33.—*Albers*, Atlas der pathol. Anatomie und Erläuterungen zum Atlas der pathol. Anatomie, Bd. III., p. 506.—*Gilibert*, Adversaria medica pr. CXXXII., Lucubr. anath. de fœtu acephalo.—*Proschaska*, Medic. Jahrbücher des österr. Staats, Bd. V.—The Dublin Hospital Reports, Vol. V., Part II., p. 311 ; see also in *Albers.*—*Ammon*, Die angeborenen chirurgischen Krankheiten d. Menschen. Berlin, 1842.—*Luschka*, Roser's und Wunderlich's Archiv, 1848, VII., 1.—*Riecke*, Journ. f. Chirurgie u. Augenheilkunde, N. F., 1845, Bd. 34, IV., 4, p. 618.—*Bednar*, Krank. der Neugebornen. Wien, 1850, I.—*Leudet*, Trois bronches naissant de la trachée, Gaz. méd. de Paris, No. 27, 1856.—*Jenny*, Schweiz. Zeitschr., 1854, 1.—*Heusinger*, Hals-Kiemenfisteln von noch nicht beobachteter Form., Virchow's Archiv, XXIX., p. 558, 1864.—*Rossi*, Mém. de Turin, T. 33, p. 168.—*Desprès*, Fistule bronchiale borgue externe chez une fille de dix ans, Gaz. des hôp., No. 146, 1866.—*Förster*, Die Missbildungen des Menschen. Jena, 1861, p. 102.—*Vrolik*, Handboek der Ziektekundige Ontleedkunde, II., 1842, Aangeborene Gebreken. —Angeborene Bildungsfehler, beobachtet von Prof. *Lehmann*, Nederl. Tijdschr., II. Afd., 1. Aflev., p. 142, 1868.— *Voigtel*, Handbuch der pathologischen Anatomie, Bd. II., p. 289.—*Th. Gass*, Essai sur les fistules bronchiales, Thèse de Strassburg, 1867, 2 Sér.—*Meckel*, Handb. d. pathol. Anatomie, No. 1, 1812, p. 481.—*Förster*, Handb. d. pathol. Anatomie, II., 211.—*Rokitansky*, Handb. d. pathol. Anatomie.—*Andral*, Préc. d'anat. pathol. Bruxelles, 1837.—*Duchek*, Handb. d. speciellen Pathologie u. Therapie, 1. Bd., III. Liefg. Die Krank-

heiten des Larynx und der Trachea, der Schilddrüse und der Thymusdrüse. Erlangen, 1873, p. 464.—*Périer*, Anomalie des Oesophagus; Obliteration seines oberen Endes; Einmündung des unteren in die Trachea in der Höhe der Bifurcation derselben. Gaz. des hôp., 1874, No. 12.

Consult, further, the manuals of surgery of *Emmert, Roser*, and *Bardeleben*, as well as especially *Pitha* and *Billroth*, Handbuch der allgemeinen und speciellen Chirurgie. Erlangen, 1871, Bd. III., 1 Abth., 3 Lfg.; die Krankheiten des Halses von Dr. *G. Fischer*, p. 15.

One portion of the congenital malformations of the trachea and the bronchi possess an anatomical interest merely, and not a clinical one, inasmuch as they exclude the viability of the affected individual. For this reason we will not devote any special consideration to them in this place. To this class belongs the complete absence of the trachea, observed in acephalous and other non-viable monsters. This condition is observed most frequently in connection with absence of the entire respiratory organ.

In other cases absence of the trachea has been observed with presence of the lungs and the larynx; the latter in such instances being in immediate connection with the lungs and the bronchi. Such cases have been reported by Blanchot, Gilibert, Klein, and others.

Atresia, blind termination of the trachea, and likewise closure of both branches of the trachea, belong, further, to the anomalies of form of anatomical, but not of clinical interest. Rossi has reported a case of the latter sort, in which he found a closure of the glottis by a membrane, in addition to closure of both branches of the trachea; Otto has likewise reported a case of occlusion of the trachea. Communication of the œsophagus with the posterior wall of the trachea belongs, further, to this category. This communication, in most instances, occurs in such a manner that the pharynx terminates in a blind extremity, and the portion of œsophagus ascending from the stomach opens into the trachea. Such a case has been reported by Schöler.[1] In this case it was remarked directly after birth that the breathing was greatly impeded by a large quantity of

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[1] See, also, *Ammon*, Die angebornen chirurgischen Krankheiten des Menschen. Berlin, 1842.

mucus; the child, in attempts to swallow, was seized with severe suffocative paroxysms, and everything taken in the shape of food was regurgitated through the mouth and nose. On dissection it was found that, in addition to the termination of the œsophagus in a blind sac, the lower portion of the œsophagus ascending from the stomach opened into the trachea. Similar cases are recorded by Lehmann, Albers, Fleischmann, and Périer.

Further malformations to be mentioned are: the absence of individual tracheal cartilages; the coalescence of several tracheal cartilages into one; an excessive number of cartilages; their abnormal division longitudinally or horizontally; and their abnormal configuration, size, and texture. Sometimes the trachea is too short, too narrow, undivided below, or unusually curved. Certain of these last-mentioned alterations sometimes implicate also the rings of the bronchi.

Among the abnormal formations of the bronchi, the third bronchus is to be mentioned. This malformation is an infrequent manifestation in the human subject. The trachea, instead of being divided into two large branches, a right and a left bronchus, is here divided into three, and usually in such a manner that there are two right bronchi instead of one bronchus. Such a division of the trachea into three bronchi was observed by Leudet in the corpse of a man dead from phthisis. The third bronchus, which was of lesser calibre than the two others, but of the same conformation, descended into the upper lobe of the right lung, which was therefore supplied with two bronchi. This anomaly had also been observed previously by Cruveilhier;[1] and has been introduced by Albers into his Atlas of Pathological Anatomy[2] as a very rare malformation, with the remark that usually two right bronchi are found instead of one.

Congenital struma (goitre) and congenital *hygroma colli cysticum* (cystic tumor of the neck) come into consideration, in this connection, only in so far as in their severer and severest grades they exert compression upon the trachea. Inasmuch as the symptoms thus produced are like those to be hereafter men-

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[1] Traité d'Anat. descr., Vol. III., p. 468, 2. édit.

[2] Band III., p. 506.

tioned in connection with stenosis of the trachea in general, further details will be referred to that subject.

Congenital bronchocele (so-called)—partial dilatation or hernia of the trachea—must also be mentioned as a very rare malformation.

In reference to this malformation Ammon[1] says, "there exists a single and very incompletely described case of congenital bronchocele reported by Gohl; in this instance there was a complication with struma; the increase of the tumor on inspiration and in crying, as well as the unaltered condition of the tumor on expiration without crying, showed the existence of the complication with bronchocele."

Finally, doubling of the trachea is to be mentioned. In double-headed monsters with a single trunk the trachea is in most instances double, at least at its commencement. Several observations of the kind are to be found in Voigtel.[2]

Congenital fistula of the neck is of much greater interest than all the malformations thus far mentioned. Our knowledge of congenital fistula of the neck, as is well known, owes its foundation and earliest scientific consideration to the labors of Dzondi and Ascherson. *Fistulæ colli congenitæ*, however, must be further divided into two principal groups, *fistulæ pharyngis* and *fistulæ tracheæ;* the latter of which only comes into consideration here.

Congenital fistula of the neck depends upon imperfect closure of the third or fourth branchial cleft; or, in median fistula, upon imperfect union of the third or fourth branchial arch in the median line (Förster). Usually the external orifice of the fistula exists on the side of the neck, half an inch or an entire inch above the sterno-clavicular articulation, either between the two heads of the sterno-cleido-mastoid muscle, or at its inner border. Less frequently it exists higher up, as far as the cricoid cartilage, and towards the median line. As a rule there is but one fistulous opening, situated most frequently on the right side, and less frequently in the median line. When, as is rarely the case, there are two openings, they are symmetrically situated

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[1] Die angeborenen chirurgischen Krankheiten des Menschen. Berlin, 1842.

[2] Handbuch der pathol. Anatomie, Bd. II, p. 298.

on each side of the neck.   In a case reported by Ascherson
there were as many as three openings observed, situated one
above the other.   The external orifice is small, as a rule, so that
it can be penetrated only by a very delicate probe or a bristle.
The borders of the opening usually project somewhat forwards ;
and they are tumid, and not infrequently reddened.   The fistu-
lous tract leads either into the larynx or pharynx, or into the
trachea.   The last-mentioned variety is exceptionally rare.
It much more frequently happens that the fistula terminates
blindly in the connective tissue of the neck ; or that, some-
times, a small cyst-like pouch is formed behind the orifice
(incomplete fistula).   The calibre and orifice of the fistulous
tract, even in those instances in which the tract opens into the
trachea (complete fistule), are usually so small that bubbles of air
are but seldom expelled externally.   In those cases in which the
fistula terminates blindly in the connective tissue, mucus only
escapes from the external orifice—as a matter of course only in a
minimum quantity.

Real tracheal fistulæ are much less frequent than incomplete
cervical fistulæ and the so-called cervico-bronchial fistulæ.
These fistulæ occur in the middle of the neck in most instances.
Sometimes there is only one simple very minute orifice ; some-
times a tumor extends from the chin down to the region of the
manubrium sterni, in the upper or lower portion of which a deli-
cate opening, the fistulous orifice, is found.   If the fistula is in-
complete, it is gradually lost, blindly, in the tissue, and permits
merely a yellowish fluid to trickle outwards.   The complete
tracheal fistula, on the contrary, presents an open communica-
tion of the fistulous tract with the trachea, and is usually
located in the middle line of the neck.   It is further worthy of
mention, that up to the present time tracheal fistulæ have been
observed almost only in females (Bardeleben).[1]   All the cases
of *fistulæ tracheæ* observed and described by Dzondi occurred
in females only.   The fistulous tract which led to the trachea
was oblique in its course in most instances, and barely permitted
examination with the probe.   The probe was introduced with

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[1] Lehrbuch der Chirurgie und Operationslehre, Vierte Ausgabe, III. Band, 1864,
p. 445.

certainty into the trachea only in a single instance of all the cases observed by Dzondi. In one instance, when the mouth and nose were closed during free and powerful voluntary respiration, air-bubbles issued on expiration out of the fistulous orifice (Ammon).

The diagnosis of congenital tracheal fistula is chiefly dependent upon the evidence of a direct communication of the external fistulous orifice with the interior of the trachea, whether it be determined by means of the probe or by escape of air through the external orifice on forced blowing and similar manœuvres.

In many cases the diagnosis is obscured by obstacles not altogether unimportant, as is shown in a case reported by Fischer,[1] which, in 1862, came under observation in Langenbeck's clinic.

A child, twelve years old, when in the fifth year of its age, had a tumor form some two inches above the manubrium sterni, and tolerably in the middle line between both sternal portions of the sterno-cleido-mastoid muscle. The tumor had been opened by means of some caustic, which left a small ulcer and a fistula. The probe penetrated about an inch and a quarter upwards, and gave exit to a stringy, tenacious mass, which contained mucus corpuscles. The first impression was that this was a case of congenital fistula of the neck, a diagnosis, however, which was excluded by inquiry into the history of the case. Apparently a lymphatic gland had undergone suppuration, and the abscess formed had descended and become ruptured lower down. The tract was cut open. It appeared clothed with epithelium, and could be followed as far as the level of the hyo-thyroid ligament. It was excised, together with the cicatrix of the ulcer. During the union of the wound air-bubbles escaped repeatedly, indicating, therefore, a communication with the air-passages, so that the case was explained as one of congenital fistula of the neck (Fischer).

The treatment, which is based on the same principles as that for cervico-bronchial fistula, belongs to the domain of surgery.

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[1] Pitha und Billroth's Handbuch, Bd. III., 1. Abth., 3 Lieferung.

CATARRH OF THE TRACHEAL AND BRONCHIAL MUCOUS MEMBRANE; TRACHEITIS, BRONCHITIS, CATARRHALIS; BRONCHIAL CATARRH.

Literature.

In the following lines we will present only the more important literature of our subject. A complete enumeration of all the works that treat of tracheal and bronchial catarrh would carry us too far, on the one hand, and be useless on the other. The older literature of this subject is cited as it is given by Biermer.[1] In the enumeration of recent literature, on the other hand, we present not only the larger monographs, but also a series of smaller articles of late date, so as to furnish the reader, if not altogether a complete, still a sufficient insight into the literature of our subject. The remark should be premised that the literature of bronchitis begins in our own century, inasmuch as before that time neither the anatomical alterations of bronchial catarrh, nor its exact symptomatology, were understood.

The name " Bronchitis " was first brought into use by P. Frank (Interpretationes clinicæ, 1812, I., 110), and Badham (An Essay on Bronchitis, 1814 ; the German translation by Kraus, 1815). While the forms of disease which are to be summed together under the term bronchitis were previously separated from each other under the most different appellations, without anything approaching a clear insight into their anatomical relations, the first accurate studies of bronchitis, both in anatomical and clinical aspects, commenced after this time. Further progress in the study of bronchitis was paved by the knowledge of its frequent occurrence in children, especially in the form of capillary bronchitis.

Regarding the older literature, we refer the reader to the citations by *J. Frank*, Prax. med., P. II., Vol. II., Sect. I., pp. 795 and 807.—*Naumann*, Med. Klin., Bd. I., p. 506 et seq.—*Copland*, Dictionary of Practical Medicine. London, 1858, Vol. I., p. 268, and Vol. II., p. 700.—*Eisenmann*, Krankheitsfamilie Rheuma, Bd. I., S. 185, and Bd. III., p. 113.—*Canstatt*, Spec. Pathol. u. Ther., Bd. III., Abth. I.

Of later and most recent literature we present the following works : *Cheyne*, On the Pathology of the Larynx and Bronchia. Edinb., 1809.—*Cabanis*, Observations sur les affections Catarrhales. Paris, 1807.—*Broussais*, Histoire des phlegmasies ou inflammations chroniques, etc. Paris, 1808.—*Badham*, On the Inflammatory Affections of the Mucous Membrane of the Bronchiæ, 1814 ; German by *Kraus*, 1815.—*Hastings*, A Treatise on Inflammation of the Mucous

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[1] Bronchienkrankheiten, in Virchow's Handb. d. spec. Path. u. Ther., V. Bd., p. 647.

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The reader may consult, further, the manuals of pathological histology, the manuals of special pathology and therapy, of the diseases of children, and of the diseases of old age.

Prefatory Remarks.

While in earlier times a catarrh was spoken of only when the secretion from the affected mucous membrane was rich in mucine, and cellular elements were only sparsely mingled therewith, at the present day the richness in certain cellular elements of a fluid secreted from a mucous membrane is regarded as an indication of a catarrhal process. If this old view is retained, and catarrh is spoken of, as by Traube,[1] only when the pathological secretion of a mucous membrane is rich in mucine, and the viscid, tenacious fluid contains but few cellular elements, and then such only as originate from the uppermost layer of the mucous membrane, it must be acknowledged that pure catarrh of the mucous membrane of the air-passages is a relatively rare manifestation. The processes which we encounter most frequently in practice, then, present a mixture of catarrh and inflammation. The designation of catarrhal inflammation has, therefore, been justly applied to this frequently occurring form of disease, both in its acute and its chronic varieties. This process is characterized by the exhibition on the part of the affected mucous membrane, not only of increased secretion of mucus, but also of the characters of true inflammation. The evidence for

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[1] *Hertel*, Mittheilung aus der Klinik von Traube. Berlin. klin. Wochenschr., 1871, Nos. 26, and 27.

the justness of this view is offered in the condition of the sputa, which are distinguished by their great richness in mucine, on the one hand, and, on the other, by the presence of more or less numerous cellular elements, especially lymph corpuscles. The reverse condition of both these factors may vary a great deal, both in the individual stages of bronchitis and in its individual forms.

In the following pages, in treating of the peculiar characters of special forms, we will at first include all these different forms in one, and then return to the subject more closely.

If it is said of catarrhal inflammations of the mucous membranes in general, that they belong to the most frequent of all forms of disease, the same remark is especially applicable to those of the mucous membrane of the air-passages. Hardly another organ evinces disorder as frequently as the mucous membrane of the respiratory apparatus; and there is hardly a second form of disease which is so generally distributed as catarrhal inflammation of the mucous membrane of the air-passages.

But, as is well known, these catarrhal inflammations progress in very different manners. Sometimes the hyperæmia and swelling preponderate; sometimes the increased secretion of the mucous membrane is the most prominent symptom; sometimes the secretion has a more mucous, sometimes, again, a serous, sometimes a purulent character; and so on. In the same manner, the course of the catarrhal inflammation presents numerous vacillations; and it is no wonder then, that, according as it has been viewed from this stand-point or that, catarrhal inflammation of the mucous membrane of the air-passages has been arranged, at all times, in a series of different subdivisions.

An enumeration of all the various classifications, which almost every individual author has arranged in his own manner, would serve no purpose here. It is evident that the classification will be different according as the subject is approached from this or that stand-point; according as the clinical course chiefly is kept in view, or the nature, quantity, and other conditions of the secretions; and so on. Certain principal subdivisions, however, have been retained in common by all authors. The difference between the individual forms of the disease is too great, not

to render it positively necessary to subdivide catarrhal inflammations into different sections.

In the first place, then, catarrh is separated into two groups, *acute* and *chronic*, according to its course. Then, according to its *seat*, we must ascertain whether the catarrh has seized upon the coarser divisions of the bronchial tubes, or is located in their finer and most delicate twigs. In this way we distinguish a catarrh of the larger bronchi, with which the trachea is also frequently implicated, as *tracheo-bronchitis*, and a catarrh of the smaller and most delicate twigs of the bronchial tree as *capillary bronchitis*.

The *extension* of the catarrhal process leads to still further discrimination. According as the catarrhal inflammation is extended over most of the branches of both primitive bronchi, or according as it is limited to a small section of the bronchial tract, we distinguish the former form as *diffuse bronchitis*, and the latter as *circumscribed* bronchitis.

Acute and chronic catarrhs of the trachea occur very seldom as isolated affections.[1] They occur, as a rule, simultaneously with laryngeal, pharyngeal, and bronchial affections.

It is, further, of great significance whether the bronchitis and tracheitis occur as a genuine primary disease, or whether they become associated in the form of a secondary affection, as a complication or result of a disease already existing. We recognize, therefore, a *primary* and a *secondary* catarrh. Further differentiations are made, too, according as the catarrhal process affects childhood, middle adult life, or old age. Not only are certain forms of catarrh observed in greater frequency at certain periods of life, but the same form of bronchitis presents itself as an unimportant affection at certain periods of life, and as a very serious one at others.

We need only recall here the analogous relations of catarrhal laryngitis, which, as a rule, presents itself as an insignificant

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[1] *Schrötter* observed (Laryngologische Mittheilungen. Jahresbericht der Klinik für Laryngoskopie an der Wiener Universität, 1871-73. Wien, W. Braumüller, 1875) only twenty-six cases of pure tracheal catarrh among 3,693 cases of diseases of the respiratory tract, while it occurred very frequently in conjunction with laryngeal, pharyngeal, and bronchial affections.

form of disease in adults, while it frequently gives rise to very alarming symptoms, on the contrary, in early childhood.

In addition to the conditions mentioned, the duration, seat, and extension of the process, its manner of origin, the age of the patient, and still other conditions have been selected as a basis for classification. Individual symptoms have been adhered to as a basis of classification, and the *nature of the expectoration* has been chiefly selected among the different symptoms as a principle for classification. In this way Laënnec,[1] starting on this principle of classification, established a series of subdivisions, and made a distinction between mucous catarrh, pituitary catarrh, dry catarrh, and the like. The majority of authors have adhered to a similar classification, founded on the varying consistence of the secretions, and have especially accepted the distinction into a dry, a mucous, a purulent, a muco-purulent, and a fetid bronchitis.

The *râles*, also, have been adhered to as a measure for classification ; and in correspondence with their division into dry and moist, bronchitis has been divided into two principal varieties, a bronchitis with *dry râles*, and a bronchitis with *moist râles*. This classification was adopted by Beau,[2] who divided bronchitis into a ''bronchite à râles vibrantes,'' and a ''bronchite à râles bullaires.''

It is readily comprehensible that the classifications maintained by individual authors must vary very much, according as they start from this or from that point of view, in delineating the various forms of bronchitis. It is self-evident that it would be a useless beginning were we to introduce here all the different classifications which have been adopted by the numerous authors who have written upon the subject under consideration. It suffices to have indicated briefly the various points of view from which a classification may be adopted.

Concerning the classification upon which will be based the following consideration of our subject, it is self-evident that we must first discriminate between two principal forms, *acute* and *chronic* bronchitis. The symptomatic features of these forms,

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[1] Traité de l'auscultation, etc.   Paris, 1819, 1837.
[2] Archiv. génér., Sept. and Oct., 1848.

however, as well as their course, their prognosis, and the like, present important differences according as only the larger bronchi, or the smaller and smallest bronchial twigs, or almost the entire bronchial tract, are affected. Physicians have justly, therefore, for a long period, made a distinction between tracheo-bronchitis, capillary bronchitis — or bronchiolitis — and diffuse bronchitis, and we, likewise, will here adhere to this classification as unconditionally essential.

Those modifications which are occasioned by age, physical condition, and the like, will come under notice in our description of these individual varieties.

Etiology.

Before we pass to the consideration of the etiological conditions in their precise sense, it will be proper to make some remarks concerning the geographical distribution of tracheal and bronchial catarrhs, and their frequency in individual climates.

Unfortunately we must here premise the remark, that statistic data in this direction are tolerably deficient. The reason for this may be in part assigned to the fact that bronchitis in general is such a widely spread disease that it has not been considered sufficiently worth while to gather exact statistics concerning the frequency of its occurrence in different climates. Frequently enough, too, sufficient discrimination has not been made between catarrh of the tracheal and bronchial mucous membrane and other lung affections, especially chronic pneumonia and tuberculosis.

As is generally known, catarrh of the respiratory organs is not only one of the most frequent of diseases, but it is also one of those most widely spread over the greatest part of the earth's surface. On this account, as already advanced by Hirsch,[1] in his admirable manual, statistics possess too few data of certainty to enable us to arrive at any mathematical conclusions as to the frequency of these forms of disease in different portions of the earth. This much, however, is firmly established, *that catarrhal affections of the respiratory organs, other things*

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[1] Handb. d. historisch-geographischen Pathologie.   Erlangen, Enke, 1862–64.

*being equal, are the more frequent the farther we proceed from
the tropics towards higher latitudes,* and that the maximum of
their frequence in different portions of the frigid and temper-
ate zones is found in general *where frequent, sudden, and severe
variations of temperature occur, in addition to the prevalence
of a moist and cold climate.*

A comparison with the geographical distribution of croupous
pneumonia is of especial interest. It appears that this is quite
different from that shown by catarrh and bronchitis. With
croupous pneumonia there is no increase of frequence, the fur-
ther we proceed from the tropics into higher latitudes, as is the
case, according to the concurring statements of Ziemssen and
Hirsch, with catarrhs and bronchitis.

Concerning the frequency and intensity of the occurrence of
these forms of disease in individual regions, we refer to Hirsch,
who has made the most accurate studies on this point, and
merely mention that a very remarkable exemption from pul-
monary diseases in general, and also from bronchitis, according
to the coinciding reports of all observers, exists in both *upper
and lower Egypt, the western prairies of North America, the
plains of India, a portion of the Antilles, California,* etc. The
generally accepted opinion that the geographic extension of
diseases of the respiratory organs bears a direct relation to geo-
graphic latitudes, so that there is a decreasing frequence from a
maximum at the poles towards a minimum at the equator, does
not apply, according to Hirsch, to all diseases of the respiratory
organs, but only to catarrh and bronchitis especially. The geo-
graphic distribution of the latter affection certainly exhibits *a
uniformly decreasing frequency from cold regions towards the
tropics.*

Among the characteristic conditions of climate in general, two
especially come into consideration : *temperature* and *humidity
of atmosphere.* From the comparisons made by Hirsch, as to
the influence of temperature upon the frequency of bronchitis,
it is evident that *these diseases, in general, increase in frequency
from lower to higher latitudes, in contrary relation to a fre-
quency existing in moderate temperatures,* notwithstanding that,
as shown by Hirsch's tables, there are many exceptions to this

rule ; so that the average temperatures of a region offer no certain standard for the frequency of these diseases.

Hirsch believes that the influence of severe changes of temperature upon the frequency of catarrh and bronchitis in general is too highly estimated, and that the dependence of the latter upon the condition of humidity of the atmosphere is much more weighty. It may be considered as firmly established that catarrh in such regions occurs most frequently and over greatest extent in those localities in which the air is loaded with moisture nearly to saturation, either periodically for long periods or continuously. Absolute admixture of vapor does not come into consideration here so much as relative admixture ; and the difference between the dew-point and the average temperature is the especial standard of measurement for estimating the humidity of a region. *The diseases named, therefore, will be principally observed at those periods of the year in which temperature and dew-point fall closely together ; in which severe thermometrical oscillations prevail in consequence of changes in the direction of the wind, and so on ;* in which the atmosphere, saturated with water, appears continuously moist, thus occasioning moderate or severe falls in temperature of longer or shorter continuance. *This period occurs, in moderate latitudes, in spring and in the latter part of autumn;* and in the tropics, at the periods of transition from the hot to the cool seasons, and *vice versâ.*

The experience that has been acquired, on the other hand, concerning the climatic condition of those regions in which catarrhs and bronchitis are seldom observed, is readily brought into accord with those laws established by Hirsch concerning the geographic extension of catarrh and bronchitis. The characteristics of these regions, remarkable for the infrequent occurrence of the diseases in question, lie *in a higher, and, above all, uniform temperature with a relatively low dew-point, and in prevailing dryness of the atmosphere.*

Experience concerning the influence of the *condition of the earth's surface* upon the occurrence and geographic extension of catarrh and bronchitis, coincides also with these views of Hirsch. Configuration, elevation, and geological consistence of the surface form important factors in the climatic characters of a

region. Concerning the elevation of surface, it is especially to be noticed that mountainous regions and high plateaus are very frequently the home of catarrhs and bronchitis.

Biermer [1] draws especial attention to the concurrence of raw winds with the prevalence of catarrho-inflammatory affections of the chest; and he believes that the favorable atmospheric conditions for the production of catarrh of the chest reside in the coincidence of raw currents of air with relatively greater humidity. Lebert [2] also adopts the views last mentioned, and draws especial attention, moreover, to the great influence of rapid depressions of temperature. We will recur to these influences in treating of special causes.

Concerning the frequency of occurrence in individual years, Lebert justly remarks that very warm, dry, beautiful years are in no wise those in which catarrh occurs the least, as is the general opinion; on the contrary, he asserts that relatively fewer catarrhs occur in years which are wet and cool, neither decidedly warm nor beautiful, because the transitions of the seasons are less precipitate in such years as these, and the changes of temperature less marked. Lebert's meteorological analyses have also proven the fact that absolute means of atmospheric pressure and temperature predispose less to catarrh of the respiratory organs than great differences and sudden changes.

It is further worthy of mention that while conditions of race are without important influence, in so far as any peculiarity of individual organization is concerned, acclimatization plays a part, to the extent of guaranteeing a certain immunity against catarrhal disease. It happens, therefore, that people who remove from a warm, uniform climate into higher latitudes, where catarrh and bronchitis are indigenous, are the more readily and more severely attacked by these diseases the greater the difference between the climatic conditions of the old and new places of abode (Hirsch).

Finally, it is worthy of remark, as Hirsch contends, in relation to the question under consideration, that in those tropical regions in which catarrh and bronchitis in general occur within

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[1] Bronchienkrankheiten, in Virchow's Handb. d. spec. Path. u. Ther., 5. Bd., p. 651.

[2] Klinik der Brustkrankheiten. Tubingen, Laupp, 1784, 1. Bd.

tolerably extensive limits, the native-born population succumb much more than Europeans, especially those recently arrived from higher latitudes.

The frequency of catarrhal inflammations during *individual months* is, self-evidently, variable. According to the data previously mentioned, the maximum of these forms of disease must fall at different periods in different portions of the globe. In moderate latitudes this period occurs in spring and late in autumn. The months most predisposing to catarrhs are those in which the severest thermometric fluctuations take place, in which the atmosphere appears continuously moist, in which changes in the direction of the wind are very common, in which frequent rains take place, and so on. This period in our own country (Germany) includes the autumn and the commencement of spring, and, to a less degree, the winter.

According to Lebert's [1] accurate statistical tables from the clinique in Zurich, 50 per cent. of all cases occur in the first four months of the year; 14 per cent. in June and July together; 14 per cent. in October and December together; 6 per cent. in May and November each; and the minimum, 5 per cent., in August and September each. Thus the last three months and the first four furnish the principal number of cases, and then there is a decrease from May on, the smallest figures occurring in the second half of the summer. The individual quarters show the figures: 1st, 39 per cent.; 2d, 24 per cent.; 3d, 17 per cent.; and 4th, 20 per cent.

In the Breslau clinique, the first four months yielded 50 per cent.; May, October, November, and December, 30 per cent.; June and July, 12 per cent.; August, 2 per cent.; and September, 4 per cent. The quarterly figures are: 40 per cent., 27 per cent., 12 per cent., and 21 per cent.; the relations of the two halves of the year = 2 : 1.

Haller's [2] results from the Vienna Hospital are somewhat different. According to Haller's tables, catarrhs of the respiratory organs culminate in January; diminish markedly in February; undergo a fresh though insignificant increase in March; sink slowly from April on, and throughout May; sink more rapidly in June, and are at their lowest in September, while there is a moderate but steady increase again from October to the end of the year.

It is further worthy of remark, in regard to frequency in individual seasons, that there is a want of coincidence between croupous pneumonia and catarrh of the respiratory organs, as is evident from different series of statistics, especially those of the general hospital of Vienna.

[1] Klinik der Brustkrankheiten, I. Bd. p. 179.
[2] Die Volkskrankheiten in ihrer Abhängigkeit von den Witterungsverhältnissen. Wien. 1860.

In leaving these remarks concerning the geographical exten-
sion of bronchial catarrh and its periodical appearance, to con-
sider its *etiological* relations, we have, in the first place, to
separate the *predisposing influences* and the special *exciting
causes*.

Though the disposition to catarrhal inflammations, as a
whole, may be regarded in general as a common characteristic
of very many persons, still there are many remarkable indi-
vidual differences in reference to the localization of the ca-
tarrhal inflammation. The disposition to disease in general,
and to catarrhal affections in particular, always bears a relation
proportionate to the general vigor of constitution. It is no won-
der that robust natures, which exhibit a greater resistance than
ordinary against all external injurious influences, should be less
disposed to catarrhal affections of the respiratory mucous mem-
brane in general. On the other hand, with increasing debility,
and with greater delicacy of physical constitution, the disposi-
tion to disease in general is increased, and so, likewise, that to
catarrhs of the respiratory mucous membrane. On this account
we see the same injurious influences meet with long-continued
and often-repeated resistance from individuals of strong natures,
while individuals of tender, relaxed natures, with anæmic or
lymphatic habit, and the like, are in great measure predisposed
to the diseases mentioned.

In general, therefore, the adage is correct, that in the case of
stronger constitutions the disposition to the diseases in question
diminishes. On the other hand, it cannot be ignored that con-
siderable fluctuations occur within these narrow limits. We are
therefore disposed to speak of a certain individual predispo-
sition, the ultimate cause of which we do not know with cer-
tainty. While one man contracts a bronchial catarrh on the
slightest exposure, such as a slight wetting, etc., a second indi-
vidual, of probably the same vigor, reacts from the same influ-
ence, or from an analogous injurious influence, with a coryza,
a third with an angina, and so on. It has become customary
in these cases to speak of a *locus minoris resistentiæ* (a locality
of less resistance), without the least intelligent comprehension
of the matter. Why, of three individuals exposed to the same

injurious influences, one should get coryza, another pneumonia, and the third bronchial catarrh, is by no means explained by the supposition that in the first the nose, in the second the lungs, and in the third the bronchi, represent the *locus minoris resistentiæ*. That certain peculiar individual conditions of tissue must exist in these instances is evident ; especially as we see it to be a fact that the same organ is repeatedly affected in the same manner by temporary injurious influences. In what, however, this individual alteration of tissue consists is, as yet, by no means sufficiently explained.

On the other hand, we also see a greater disposition to diseases of the bronchial mucous membrane developed as a consequence of debilitating diseases of long continuance. Such secondary bronchial catarrhs are met with in the wake of numerous acute and chronic diseases. In these cases the disposition is increased, on the one hand, by reason of the preceding acute or chronic disease ; but its origin is often to be sought for, on the other hand, in the circulatory disturbances occasioned by the fundamental disease. We need only recall, here, the frequent occurrence of bronchitis in diseases of the heart, especially in insufficiency of the mitral valve, in Bright's disease and the like. For particulars concerning these secondary bronchites we must refer the reader to the appropriate sections.

Sex, at any rate, plays only a subordinate rôle in reference to the disposition to catarrhal inflammations of the respiratory mucous membrane. The assertion has been repeatedly made, that men more than women contract bronchitis. This view has much apparent plausibility. The differences of employment and the manner of domestic life appear to account very well for such a different condition in the sexes. As yet, however, there is no precise statistical evidence of the justness of this view. But few exhibits of figures on this point are to be found in medical literature. It is self-evident that all those statistics, presenting merely the figures of mortality, such as those of Copland,[1] for example, cannot be made available for the decision of this question. According to the few statistics of mortality that are acces-

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[1] On Consumption and Bronchitis, etc. London, 1861.

sible, there is much plausibility for the view of the greater frequency of these affections in males. Lebert (l. c.) also has exhibited a preponderance in favor of the male sex, in his very accurate statistics from the cliniques at Breslau and Zurich. According to Lebert's tables, bronchitis of all forms shows this sexual preponderance in the proportion of seven males to six females. It must not be forgotten, in this connection, that hospital statistics are insufficient for the decision of this question. The most plausible explanation of this difference is that which refers it chiefly, if not exclusively, to the difference in the avocations of the sexes.

Concerning the *period of life*, it has long been a correctly ascertained fact that, although bronchitis is observed at every time of life, there are certain periods in which it occurs with preponderating frequency. It is especially frequent in infancy. As is readily comprehensible, the respiratory organs of children are much more sensitive to atmospheric and other injurious influences than those of adults, and this explains at once the greater prevalence of respiratory diseases in childhood, in contrast to that of adult life. The rôle, however, played by habitude or inuring, has been recently exhibited by Geigel,[1] in a very admirable exposition of the infant mortality at Würzburg. According to his observations, comparatively more legitimately born children die of respiratory diseases in the first year of life than illegitimate children; while the latter class succumb in greater number to diseases of mal-nutrition. While the latter circumstance is to be attributed, without doubt, to impaired nutrition, to which illegitimate children are naturally more exposed, in the melancholy conditions under which they are placed, and most so during the hot season, the preponderance of respiratory diseases among the more favorably placed legitimate children can only be referred to the greater enervation to which they are subjected by the anxious mother, who keeps them in the room during every little raw puff of air; and this enervation so increases their disposition to disease as to over-balance the otherwise slighter resisting powers of the poorly matured illegitimates.

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[1] Deutsche Vierteljahrsschr. f. öffentl. Gesundheitspflege, III., 520.

In spite of this, a slighter resistance of the infant organism to external, and especially to atmospheric injurious influences, in contrast to that of adults, cannot be questioned. West[1] has further proved, by the aid of statistics, that inflammatory respiratory diseases are less frequent during the first six months of life than during the succeeding eighteen months; and he endeavors to explain this by a greater sensitiveness of the respiratory mucous membrane, at a later period, than in the newborn babe. Biermer has justly rejected this view as unfounded; and he prefers the self-evident explanation that children, as a rule, are more carefully protected from unfavorable atmospheric influences during the earlier months of life than at a later period. Perhaps, also, the process of dentition may play a certain rôle in this connection, even though but a distant one.

According to Lebert all forms of bronchitis collectively (catarrh of the coarser bronchi, bronchitis diffusa, and bronchiolitis) exhibit an average of 27 per cent. for the first ten years of life, 25 per cent. for the second, 15 per cent. for the third, and 17 per cent. for the fourth decennium. After this period the average on the whole is only 8 per cent.

A very different numerical relation appears, however, if the frequency of the individual forms of bronchitis at the different periods of life are considered separately.

As in childhood, so again in old age, diseases of the respiratory mucous membrane play a major part. This is explicable by the rarefaction that the pulmonary tissue undergoes, in connection with the same conditions of all the tissues, in advanced life; by the general feebleness of body, and in part, also, by the special alterations in the heart, the great vessels, and the like, attendant upon old age.

As a general thing the disposition to bronchial catarrhs is relatively less in adolescence and vigorous manhood. It must be maintained, withal, that the individual forms of catarrh exhibit very important differences in this respect. While, for example, chronic bronchial catarrh is to be reckoned among the

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[1] Lectures on the Diseases of Infancy and Childhood. London, 1853. Philadelphia, 1860.

forms of disease by no means infrequent in middle age, we observe the same affection relatively infrequently during the earlier periods of life. Instead of this, the acute forms, especially bronchiolitis, are observed the more frequently. Secondary catarrhs, as resultant conditions from cardiac insufficiency, emphysema, asthma, and Bright's disease, are, accordingly, relatively more infrequent also in childhood than in the period of completed growth. But it must always be maintained, that although the relative frequency of bronchitic affections is variable at the different periods of life, diseases of the bronchial mucous membrane are to be reckoned among the most frequent of all forms of disease at all periods of life.

With respect to the special *exciting causes*, an important etiological rôle has always been attributed to "*taking cold*," without our always having any very clear notions of the meaning of that term. A satisfactory physiological explanation of the process of taking cold has never yet been advanced. The fact, as such, that a man becomes sick immediately after this taking cold, and in direct consequence of it, has long stood as firmly established. From the remotest period men have included under the term "catching cold," not only the inspiration of moist and cold air, but *every too severe and sudden cooling of the entire body, or a portion of it.* Experience showed that sometimes a thorough wetting, sometimes a cold draught of wind upon an over-heated and perspiring body, sometimes the sojourn in a freshly cleansed, still wet room, and similar injurious influences were immediately followed by the onset of the diseases under consideration. The occasion for the exertion of most of these injurious influences is naturally greatest at times of changes in the weather, and at times when the weather is moist and cold ; and hence it is easy to understand how, when these causes are specially prevalent, the number of these diseases must also increase. It is evident, however, that the exciting causes mentioned may act as favoring factors of disease at every period of the year, independently of season, and thus give rise to catarrhs at any time.

With reference to the process of "catching cold," its physiological explanation is as yet wanting, as already mentioned. In this relation the experiments and

researches recently reported by Rosenthal,[1] seem to me to be of significance. Rosenthal, in his experiments upon the retention of animals in elevated temperatures, placed the animals in a peculiarly constructed hot box, as had been done by Ackerman[2] and myself[3] in our analogous experiments. He has observed the characteristic fact, which I can fully substantiate on the basis of numerous experiments of my own, that when the animals are removed from the hot box and replaced in the ordinary temperature of the apartment, the temperature sinks not to the normal degree only, but below it. For this Rosenthal has offered the following, and, as it appears to me, excellent explanation. The blood-vessels of the animals become paralyzed in the high temperature ; more blood then courses through the skin than under normal conditions, and in spite of the reduced difference of heat, the animal loses so much heat that its own heat increases but little proportionately. If it is now replaced in a room at the ordinary temperature, its vessels still remain paralyzed for some time, and for a longer period, the higher the temperature to which it had been previously subjected, and the longer it has remained in this high temperature. Now, in the considerable difference between its own temperature and the temperature of the apartment, the animal must lose much more heat than a normal animal loses in the same apartment. Its own heat, therefore, declines, and not only down to the normal degree, but also considerably below it. The cause of this decrease, therefore, is to be sought principally in the *paralysis of the vessels*.

Rosenthal believes that this fact of the subsequent decrease in temperature is calculated to throw some light upon the process of " catching cold." He recalls, in the first place, the generally known fact that taking cold occurs most readily in the sudden transition from a higher temperature to a lower one. There can be no doubt that the sinking of the body temperature below the normal standard may also occur in human beings, if they are exposed to high temperatures and then return to moderate temperatures. Temperatures of from 30° to 35° C. (86° to 95° F.) are not at all impossible in dancing and other saloons; and people frequently pass from these high temperatures into temperatures lower than those employed in the experiments mentioned. Now, in such hot places the temperature of human beings must increase above the normal degree, and sink again afterwards, on the other hand, below the normal degree. This cooling, in itself, however, does not yet represent any " taking cold." To effect this injurious influence, another element must be added, and that is the *suddenness of the transition*. If the heated body, with its enormously dilated superficial vessels, is suddenly exposed to cold, there is not only a considerable amount of heat abstracted, but the blood of the superficial parts of the body so suddenly cooled now courses through the internal organs, and cools these off much more suddenly than would be the case from the simple influence of

[1] *Rosenthal*, Zur Kenntniss der Wärmeregulirung bei den warmblütigen Thieren. Programm zum Eintritt in die med. Facultät und in den Senat der k. Universität zu Erlangen. Erlangen, 1872.

[2] Deutsches Archiv f. klin. Med., VI., 359.

[3] *Riegel*, Pflüger's Archiv, V., 629.

cold without the previous influence of greater heat. The cooling off, therefore, is not only more considerable, but also much more rapid. This sudden cooling may then, in itself, act as an injurious influence, and excite a disease in this or that organ, especially if it is already enfeebled and hence less resistant.

According to this exposition it may be understood how the disease under consideration may be excited, in persons disposed to catarrh in general, in consequence of a sudden cooling off of the entire surface of the body, or one portion of it. It is further comprehensible, why one man will acquire one disease, and another man another one, from exposure to the same injurious influence. According as in the one case one organ, and in another case another organ, is the *locus minoris resistentiæ*, sometimes this disease and sometimes that disease will result from the same exposure. We are, moreover, the more inclined to presuppose a slighter power of resistance in the one organ or in the other, because experience frequently shows that the same or similar injurious influences always produce the same disease in the same individual.

It is hardly necessary, therefore, to insist more particularly upon the importance of a methodical invigoration of the body, as a preventive measure against taking cold. We will have occasion to enter into detail on this point when treating of prophylaxis. Here we may simply again recall the verification of the fact, already mentioned as proven by Geigel (l.c.), as an evidence of the great rôle played by pampering : viz., that comparatively more legitimate than illegitimate children die of respiratory diseases in the first year of life, while the latter class suffer in greater numbers from diseases of mal-nutrition.

Among the further causes of tracheal and bronchial catarrh, *injurious admixtures in the atmosphere* play a very important part. It is only recently that the so-called *diseases from the inhalation of dust* have been better appreciated than formerly ; and for this we are especially indebted to Hirt,[1] who by his thorough researches has shown the great influence that employments and the sojourn in an atmosphere filled with injurious admixtures have upon the general health of the laborer, and

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[1] *Hirt*, Die Krankheiten der Arbeiter. Breslau, 1873.

upon the occurrence of respiratory diseases in particular. We must therefore refer those especially interested in this question to his excellent monograph.

It is clearly evident that the diseases to which injurious admixtures in the atmosphere chiefly predispose, must especially concern the respiratory organs. "If a workman," says Hirt, " of that class to which Ramazzini has already applied the term 'dusty handiworker,' breathes during the greater part of the day in his workshop filled with dust, or in the working room of a manufactory, then with every breath of air a smaller or greater quantity of fine, dusty molecules will be carried into the respiratory tract, by means of which it is uninterruptedly exposed to mechanical irritation."

Accordingly we find a high percentage of diseases of the respiratory organs among workers in dust, and indeed *a much higher percentage than with others who are not exposed to the action of dust.*

Among the different diseases of the respiratory organs of workers in dust, catarrhs of the respiratory organs, and among these again chronic bronchial catarrh, take the first rank. These result from the influence of all dusty avocations, even those otherwise relatively uninjurious, but by no means with equal frequence. According to the researches of Hirt, these catarrhs are more frequently produced, on the average, by the inhalation of *the dust from vegetable substances ;* then follow, with less activity, *metallic dusts ;* then, still less actively, *animal dusts ;* while mineral particles close the series as the least injurious in general. The so-called " compositions " exercise, according to Hirt, an evil influence upon the respiratory organs of the workmen, similar to that caused by vegetable dust. Among the various diseases occasioned, chronic bronchial catarrh in particular occurs most frequently among workers in dust. There are even avocations in which almost every individual working at them for a long time suffers from bronchial catarrh ;—modelers, millers, and workers in coal, for example, are the chief sufferers in this respect.

Concerning the relative frequency of chronic bronchial catarrh among the individual workers in dust, we must refer to the tables of Hirt. We may the more readily dispense with a closer discussion of these relations, because they have already received special consideration in another volume of this Cyclopædia [1] from the pen of Merkel, so especially well versed in this very question. It is self-evident that the special diseases from the inhalation of dust, which are only produced

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[1] Vol. I. of the German edition. Omitted from this edition for reasons already stated.—EDITOR'S NOTE.

by the inhalation of a particular form of dust, such as *anthracosis, chalicosis,* and the like, do not enter into the theme before us.

The inhalation of gases and vapors is to be mentioned as a further cause of catarrh of the tracheal and bronchial mucous membrane. Concerning this, however, there is an important difference between the diseases thus caused and those occasioned by the inhalation of particles of dust. While in the action of dust upon the respiratory organs, primary bronchial catarrh almost always occurs as a result of the mechanical irritation, before any more deeply seated disease of the lung can take place, gases and vapors excite bronchial catarrh only when in the condition of great attenuation. When breathed in a concentrated condition, on the contrary, the severest symptoms may occur in the shortest time, without any previous catarrh of the respiratory mucous membrane.

It is also shown here, in a manner analogous to that occurring in the inspiration of dust, that catarrh of the air-passages is not occasioned with uniform frequency by the different gases and vapors. Hirt represents it as probable, on the basis of numerous observations and experiments, that it occurs most often, relatively, after the inhalation of *hyponitrous acid fumes* and *those of nitric acid;—sulphuric acid* follows in the second rank. *Muriatic acid vapors* produce it relatively infrequently; sometimes it is observed after the inhalation of small quantities of *chlorine gas.* Acute bronchial catarrh among workmen from inhalation of iodine appears to be exceptional.

Although chronic catarrhs are by no means infrequent after the inhalation of gases and vapors, their frequency is certainly not equal to that occasioned by the inhalation of dust. It appears, as remarked by Hirt, that the inhalation of injurious gases—and to a certain extent, also, of dust—may perhaps be borne without further bad results after it has excited acute catarrh once or several times; the workmen thus becoming gradually accustomed to the gaseous atmosphere without experiencing any difficulty on the part of the respiratory organs.

Hirt draws attention to a second point in explanation of the fact that chronic bronchial catarrhs are less frequent after the inhalation of gases in general than after the inspiration of dust. While all forms of dust possess more or less the common characteristic of exciting chronic bronchial catarrh when they come in contact with the mucous membrane of the respiratory organ, we see on closer consideration of the various gases and vapors that there are not only some which can be breathed without exciting catarrh, but also not an inconsiderable number which possess the property of diminishing a disposition to catarrhal disease, and even of contributing to the favorable termination of a catarrh already existing. To this class belong the

vapors from oil and from glue, the vapors produced by burning tar, and, furthermore, *salt-air*, the air prevailing in the vicinity of drying-houses.

That inflammations of the tracheal and bronchial mucous membrane may also be occasioned by large *foreign bodies* which gain access into the air-passages, in a manner analogous to that occasioned by particles of dust, hardly requires any further special mention. Usually the inflammation excited by foreign bodies is circumscribed, and limited to the immediate vicinity of the locality directly irritated by the foreign body. The symptoms of local inflammation in these cases, however, unless deep-seated inflammation, ulceration, abscess, and the like are excited, recede so far in the background, in contrast to the symptoms directly occasioned by the obstacle to respiration, that they hardly come even into remote consideration.

A further cause of catarrhs of the tracheal and bronchial mucous membrane lies in the *transient contagions* by which they are occasioned, such as epidemic influenza, whooping-cough, and, in a more indirect manner, by a further series of infective diseases—measles, small-pox, and the like.

Inflammatory foci may also be occasioned by the local irritation which occurs from the eruption of the pustules in small-pox. Pustules occur, not altogether infrequently, at the point of division of the bronchi, as Wagner [1] has shown. Among 170 cases, carefully examined, Wagner found pocks in the pharynx, larynx, and trachea, in fifty-four cases; in the pharynx, larynx, trachea and larger bronchi, sometimes as far as the bronchi of the second and third order—especially, however, at the points of division of the bronchi—in fifty-two cases.

In a previous part of this article we have especially indicated, among the predisposing elements of tracheitis and bronchitis, various diseases of the heart, especially those valvular insufficiencies which are associated with impediment to the pulmonary circulation. It is self-evident that it only requires the development of these affections up to a certain degree to justify us in regarding them also as direct exciting elements. The hyperæmia

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[1] *Wagner*, Die Todesfälle in der letzten Pockenepidemie in Leipzig. der H, Archeilkunde, 1872, p. 107.

thus occasioned must, in these cases, form the starting-point for all those disorders which are collectively included under the name of catarrhal inflammation ; and even the hyperæmia must be regarded as one of the most important original elements of their production.

In an analogous manner a series of other affections, which in their milder grades can only be designated as predisposing elements, may become direct exciting causes when they are further developed. This applies, for example, to various diseases of the lungs.

Finally, we observe bronchitic affections as a secondary condition in a great number of infective diseases. Thus bronchitic symptoms are almost constantly observed in typhoid fever. Here, in addition to the feebleness of the circulation, the dorsal decubitus favors its occurrence, as is shown by the appearance of pulmonary hyperæmia and bronchial catarrh in the most dependent portions of the lungs ; and especially by the results of hydrotherapy. In the same manner secondary bronchitic affections are not infrequently observed in Bright's disease, in various cerebral diseases, in certain dyscrasic conditions, and the like.

It follows from what has been said that we must distinguish a *primary* and a *secondary* mode of origin for bronchitis. In the primary cases, the injurious influence immediately excites an inflammation of the bronchial mucous membrane. We see secondary bronchitis make its appearance with especial frequency in all those affections which disturb the lesser circulation mechanically ; to which category diseases of the heart belong chiefly, and among these again insufficiency of the mitral valve plays the first rôle. Then we have aneurisms of the aorta, tumors of the mediastinum, exudations into the pericardium, and other affections of similar character.

It must be remembered here, in order to comprehend the method of origin of many of these bronchial catarrhs, that the bronchial arteries given off from the aorta or intercostal arteries give up only a portion of their blood to the bronchial veins, from which the blood enters into the azygos vein, and, further, into the vena cava. A portion of the blood of the small bronchial veins flows within the substance of the lung in the pulmonary veins. It follows from this that an insufficiency and stenosis

of the bicuspid valve, by means of which the emptying of the left auricle, and also of the pulmonary veins is impeded,—that an aneurism, a mediastinal tumor, in short, any of those affections which may exercise compression on these veins, will give rise at first and principally to hyperæmia of the lungs (*i.e.*, to a distention of the capillary reticulum of the alveoli) ; and that when these affections are of a high grade, a chronic bronchial catarrh will be one of the manifestations most frequently observed. This circumstance will be comprehensible, in the first place, by the fact that a portion of the blood flows from the bronchial mucous membrane not into the right heart, but into the left one. The circumstance, also, that most chronic diseases of the parenchyma of the lungs show a tendency to become complicated with bronchial catarrhs, is in part explained by the vascular arrangement just mentioned (Seitz, Niemeyer).

Furthermore, all those diseases of the bronchial mucous membrane in which the inflammation of a neighboring organ has become extended upon the bronchial mucous membrane, must be included in the category of secondary affections. Thus inflammations of the larynx, trachea, the parenchyma of the lungs, and the like, are not infrequently extended directly upon the bronchial mucous membrane.

Anatomical Alterations.

The name "*catarrh*," with which tracheal and bronchial catarrh have been designated according to an old-established custom, is evidently taken from but one manifestation of the catarrhal inflammation, and that is the *hypersecretion of the mucous membrane.* It must not be forgotten, however, that this forms but one link in the chain of manifestations. It must be retained in mind that this hypersecretion is almost always associated with an hyperæmia of the mucous membrane, and that the hyperæmia represents the primary manifestation, and the hypersecretion only a partial one. Swelling, turbidity, pigmentation also, under certain circumstances hypertrophy or atrophy, hemorrhage, etc., are to be designated as further, and in part important, features of the catarrhal inflammation. It is the sum of these manifestations which represents the symptomatic picture of catarrhal inflammation. The disturbance of the circulation of the blood, therefore, although an important link in the chain of catarrhal inflammatory manifestations, is nevertheless in no manner sufficiently important as such.

The *hyperæmia* itself, again, may be of a different kind, active or passive. Active hyperæmia is the direct sequence of the injurious influence which has occasioned the inflammation. Passive hyperæmias, on the contrary, often precede the characteristic bronchitis for a long time, especially in those diseases which are associated with a disturbance of the pulmonary circulation. These affections thus exert a certain predisposition to the catarrhal inflammations under consideration. There is no reason to separate these secondary catarrhs altogether from special catarrhal bronchitis, as has been attempted by Monneret.[1] Though there may be some differences, there is no essential difference between this and the remaining forms of chronic bronchitis, either in an anatomical or in a clinical point of view.

Swelling of the mucous membrane is to be designated as a second anatomical element of the catarrhal inflammation. That it stands in intimate and direct relation to hyperæmia is self-evident, even though it must be borne in mind, on the other hand, that the swelling in no wise always progresses exactly parallel with it.

The third important element of catarrhal inflammation lies, as the name "catarrh" already indicates, in the *alterations which the secretion of the mucous membrane undergoes in consequence of the catarrhal inflammation.* Important and significant as this very symptom is for clinical observation, just so erroneous would it be to consider catarrhal inflammation as simply an increase or anomaly of secretion. We have already referred to these differences between catarrh proper, as an altered secretion of the mucous membrane, and catarrhal inflammation.

According as, in individual cases, this symptom sometimes preponderates, and sometimes that one, while the remainder recede more or less in the background, a series of different forms come under consideration. Sometimes the hyperæmia preponderates, sometimes the swelling, while the secretion is much diminished, or even fails altogether; sometimes the increased secretion is the chief symptom; and so on.

In considering the anatomical alterations, it must be borne in

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[1] Traité élémentaire de Pathologie interne, T. I., 1864.

mind, in the first place, that all of the features mentioned as peculiar to the catarrhal inflammations are not always anatomically demonstrable. Neither the hyperæmia nor the swelling is to be detected in the corpse in every case of catarrhal inflammation. Often, and especially in cases of slight degree, the hyperæmia is no longer distinguishable upon the corpse, notwithstanding that there is every reason to maintain that it had existed during life. Not infrequently this manifestation recedes so much in the act of dissolution, and after death, that hardly any indications of its existence remain. So also the swelling of the mucous membrane fails in not a few instances, while it is very pronounced in others. Often the swelling of the mucous membrane appears less in the corpse than had been anticipated on the basis of the clinical manifestations. This is especially justified by the analogy with other mucous membranes, particularly of the larynx, the accurate inspection of which during life no longer presents any difficulty. In the larynx we can readily become convinced, from the much more considerable swelling so often observed during life, in comparison to that observed after death, that the anatomical examination affords no trustworthy data for judgment concerning the degree and intensity of the swelling which had existed during life.

Concerning this point, the individual mucous membranes, as is well known, by no means comport themselves in the same manner. While many mucous membranes offer but a very slight resistance to dilatation of the vessels, on account of the delicacy of their epithelial layer and the softness of their tissue, other mucous membranes, and especially the mucous membrane of the respiratory apparatus, are much less favorably disposed to the occurrence of severe hyperæmia and swelling. This depends, in the first place, upon the richness of the mucous membrane in elastic fibres. With the greater richness of the mucous membrane in elastic fibres the obstacles increase which oppose dilatation by hyperæmia. The richness of the respiratory mucous membrane in elastic fibres thus renders it readily explicable how the elastic force, under certain conditions, overcomes the pressure exerted on the part of the vessels, and how, in cases in which severe hyperæmia and swelling existed during life,

the demonstration of this condition is no longer possible after death.

The hyperæmia and vascular injection, which, as already mentioned, represent one of the most important features of bronchitic manifestations, may exhibit very different grades both in intensity and in extent. Sometimes the reddening is altogether uniform, and extended diffusely over the mucous membrane of the trachea and many bronchial twigs; sometimes it presents only a very fine punctiform capillary injection; and sometimes, again, the mucous membrane is reddened, throughout a greater or smaller extent, in the form of individual disseminated foci.

The color of the hyperæmic portions of the bronchial mucous membrane is equally changeable. Sometimes it is a more clear red, especially in the acute primary forms of bronchitis; sometimes it is of a darker, even blue-red color, as in severe forms of chronic, and especially of secondary, bronchitis.

The degree of injection varies likewise in reference to the depth to which it extends. Thus in mild forms of catarrhal inflammation the injection extends only over the superficial capillary reticulum of the mucous membrane; in severe grades and in long-existing inflammations the injection may extend as far as the submucosa, and still more deeply.

With reference to the extent of the hyperæmia, it does not often happen that the bronchial tract presents a uniform reddening of its mucous membrane in all its branches down to its terminal twigs. In acute genuine cases the reddening is most frequently limited to the inferior portion of the trachea and the larger bronchi, or in part to the medium-sized bronchi also. On the contrary, in secondary catarrhs, those of diseases of the heart, for example, the reddening, though by no means uniform in all parts, is nevertheless often extended over the greater portion of the bronchial tree. As with the degree of hyperæmia, so also its extent must be very different, according to differences in the etiological elements, the duration and intensity of their influence, and the like.

Here and there, especially in old catarrhs, the mucous membrane is not infrequently found so pale as to look gray, only

isolated small vessels glistening through it. The possibility of a mistake, therefore, is very probable in such cases.

Swelling represents the second important symptom of inflammation of the tracheal and bronchial mucous membrane. This again depends in part upon the increased fulness of the vessels, in part upon the nutritive changes occurring in the tissue itself, and in part upon the greater saturation of the mucous membrane with serum.

This increased serous saturation of the mucous membrane, which often imparts to it a characteristic velvety appearance, a certain lardaceous aspect, plays a great part, especially in diseases of obstruction. If an incision is made into these parts, a tolerably clear serum escapes from them. The more, too, the deeper layers of the bronchi participate, not only in the hyperæmia, but in this serous saturation also, the more considerable must the swelling become. If the swelling affects the narrower and finer bronchi principally, the passage of the air is greatly impeded, or even rendered entirely impossible. The relative narrowness of the finer bronchi in children renders it readily intelligible how somewhat severe conditions of swelling may even completely prevent the entrance of air under certain circumstances.

The nutritive changes that have been arrested in the cells also contribute, in a measure, although only in a slight measure, to this increased swelling of the mucous membrane. In the acute forms of the disease, the catarrhal inflammatory process is limited to the special tissue of the mucous membrane, and in these cases, therefore, the swelling in most instances is merely moderate. In cases of longer duration of the affection, and in cases of frequent recurrences of acute catarrh, on the contrary, severe grades of swelling readily remain behind, especially because the infiltration is often not confined to the mucous membrane alone. The process then no longer concerns chiefly a cellular infiltration of the sub-epithelial connective tissue only ; for with the frequent recurrence of such catarrhs, or in catarrhs of protracted existence, we see the number of cells in the connective tissue of the mucosa undergo gradual increase ; the epithelium and also the glandular apparatus take part in the

enlargement, and the mucous membrane *in toto* passes into the condition of hypertrophy. We thus see *hypertrophy of the mucous membrane* as a significant result of protracted or frequently recurring catarrh. These alterations are almost always bilateral in old cases of bronchitis.

While, however, in the trachea, the chronic inflammatory process eventually produces an enlargement of the mucous glands (even to the size of a hemp-seed and larger), and moderate hypertrophy of the mucous membrane, inveterate catarrh of the bronchi may result in a series of much more important alterations, among which bronchiectasis (dilatation of the bronchi) assumes the most important rôle.

As is well known, we distinguish a saccular, a spindle-formed, and a cylindrical dilatation. Saccular bronchiectasis will not be further alluded to here, inasmuch as it stands in intimate connection with alterations in the parenchyma of the lungs. A cylindrical ectasia of the larger bronchi of one or of several lobes occurs not unfrequently as a result of inveterate catarrh. In these cases the walls of the bronchi are thickened for the most part, and are encompassed externally by thick connective tissue that radiates in the surrounding tissues. The free surface of the mucous membrane exhibits, further, some ledge-like projections, arranged partly longitudinally, and partly horizontally, and which are especially prominent on the soft non-cartilaginous side of the bronchus, and between the cartilaginous portions of the opposite side. In this way the hyperæmia often reaches a very considerable grade, and is so superficial withal, and the color is so uniformly clear, that it not infrequently has the appearance as though there were a suffusion with blood (Rindfleisch.)

A microscopic examination discloses the fact that there is here a very advanced grade of development of the connective-tissue constituents of the bronchial walls. The ledge-like projections consist of a very richly cellular germinal tissue, which encloses longitudinal and horizontal bundles of elastic fibres; that is to say, it is the normal, so-called inner fibrous sheath in a hyperplastic condition. While the muscular element is unaltered, the inner fibrous layer lying on the inside of the cartilag-

inous rings is considerably thickened. Numerous wide blood-vessels penetrate this layer and send equally wide communicating canals through the muscular layer to the inner fibrous layer, where there is a thick capillary reticulum, especially upon the ledge-like prominences (Rindfleisch).

The cartilages of the dilated bronchi also exhibit a series of alterations worthy of notice. A portion of the cartilage disappears with the formation of spaces along its periphery, which are filled with a young connective tissue carrying vessels. At the same time the mucous glands disappear also, and their place is occupied by the young connective tissue developing from the neighborhood. Rindfleisch not inaptly designates this process as a supplantation of the cartilage by the encroaching growth of the irritated connective tissue of the neighborhood.

Biermer describes the outgrowth of the vessels of the mucous membrane into papillary loops, as a result of long-continued and frequently recurring catarrh. In these cases the mucous membrane is very much swollen, hyperæmic in a high degree, uneven, and filled with very small elevations corresponding to the papillary growths. These, according to Biermer, are usually directed in the longitudinal diameter of the bronchi, or they are in such close contact with each other that the mucous membrane at the localities affected appears shaggy or like granulating gland substance.

The last-mentioned conditions represent alterations that belong to the domain of hypertrophies. Even chronic bronchitis, in its further course, not infrequently leads to such hypertrophies. Even the bronchial cartilages may participate in this hypertrophy, and it is the medium-sized bronchial twigs, less frequently the smaller and smallest ones, which become affected with this thickening.

Diverticulum-like bulgings occasionally occur in the trachea, under the influence of chronic inflammations ; to which circumstance Rokitansky was the first to direct attention.

While the termination in hypertrophic conditions, principally induced by extensive hyperplasia of the connective-tissue constituents of the bronchial wall, is not a thing of rare occurrence, processes of softening and maceration are only seldom observed

as results of the catarrhal inflammation. Ulcers of the mucous membrane, which are due to suppuration or partial necrosis, are exceedingly exceptional in both simple, acute, and chronic bronchial catarrh. In like manner, actual softening of the mucous membrane is only exceptionally observed, and then in putrid bronchitis. Atrophy of the mucous membrane, even with larger or smaller—though usually only epithelial—losses of substance, is, on the contrary, not infrequently observed.

Disturbance of the secretion has been described as the third important element of tracheitis and bronchitis. The alterations which the secretion of the mucous membrane undergoes on account of the catarrhal inflammation, are of special clinical significance. Indeed, owing to this symptom, it has been believed proper to consider catarrhs as mere anomalies of secretion ; and even at the present day genuine catarrhs are considered in this light, and are accordingly separated from the catarrhal inflammations.

The disturbance of secretion, which continues during the entire existence of the catarrhal inflammation, may present the most numerous modifications in reference to both *quantity* and *quality*.

As a matter of course, increase of secretion is more frequently observed, and a diminution or an entire absence of secretion, less frequently.

The secretion furnished by the follicles of the respiratory mucous membrane is secreted, under normal conditions, just in quantity sufficient to maintain the mucous membrane constantly moist and smooth. It is otherwise in cases of acute or chronic catarrhal inflammation, in which important deviations in quantity and quality of this secretion are present. Even in the individual stages of catarrhal inflammation we see alterations of this pathological secretion appear ; these alterations, however, are more apt to escape observation in their finer gradations than is the case in other mucous membranes, as, for example, that of the nose. The changing consistence of the secretion in the different stages of acute catarrh of the nasal mucous membrane is familiar to every one ; and similar alterations are also encountered at different periods of acute bronchial catarrh. Thus, in acute

catarrhal inflammation of the nasal mucous membrane, we first observe a state of dry swelling of the mucous membrane in which all secretion fails ; then a stage follows in which a saline watery fluid is secreted ; then a tenacious, translucent mucus follows ; and finally a secretion rich in cells is discharged.

In a similar manner the amount and quality of the bronchial secretion vary, according to the different stages of the catarrhal bronchitis.

In acute bronchitis there is, as a rule, a tolerably protracted stage, in which secretion fails altogether, or in which it is only exceedingly slight. This is the stage of the so-called *dry swelling of the mucous membrane*. After a time, the secretion becomes more copious. The secretion now furnished still consists principally of the elements of the normal secretion from the mucous membrane, only in increased quantity ; it is purely mucous, and consists chiefly of a tenacious, translucent mucus, and very few formed elements, such as mucus corpuscles ; it runs together in the vessel, and contains air-bubbles ; it is frothy (*sputum crudum* of the older authors).

This lower grade of catarrhal inflammation is often incorrectly designated by the name of *mucous catarrh*, or *catarrh*.

If, on the contrary, the irritation has become more intense, or even if the affection has simply been of long continuance, further metamorphoses of the secretion are observed. This alteration of the secretion culminates in *an increased casting-off of cell-elements*. In connection with this, the originally more viscid mucous secretion gradually becomes looser, but, at the same time, more turbid, because more rich in cells. It now contains many pus-cells in addition to the mucus. It acquires a greater consistence, the cellular elements gradually preponderating more and more ; and the sputa show a tendency to form balls, then representing the *sputa cocta* of the older authors.

As in the acute, so also in the chronic stage of bronchitis are manifold variations of the secretion coating the bronchial mucous membrane encountered. Here, also, cases are observed in which the secretion is exceedingly scanty ; and again other cases in which the secretion is exceedingly copious, as in the so-called broncho-blennorrhœa, or the so-called pituitous catarrh of

Laënnec.   At one time the secretion is chiefly mucous in char-
acter, at another, purulent; and then again it has more of a
mixed character.   Hence, according to the extent, duration, and
intensity of the catarrhal inflammation, we see, even in the
corpse, great differences in the condition of the secretion coating
the bronchial mucous membrane.

The microscopic examination of this secretion furnishes differ-
ent results, according to the different forms and stages of the
bronchitis.   At one time the mucous elements predominate, at
another the purulent, and at still another the epithelial.   On
this account, also, some authors have discriminated between a
mucous, a purulent, and an epithelial catarrh.   The discrimina-
tion into epithelial and into purulent catarrhs is hardly practi-
cable in reference to inflammations of the bronchial mucous
membrane, because the epithelium is thrown off in barely greater
quantity than usual even in severe catarrhs.   With reference to
other localities, on the contrary, this discrimination is amply
justified.   Thus, for example, a pure epithelial catarrh of the
lingual mucous membrane is observed not infrequently ; the
entire coating of the tongue here often represents nothing else
but a scaling-off in mass of the pavement epithelium.

Biermer, also, has expressed an opinion averse to this discrim-
ination into epithelial and purulent catarrhs of the respiratory
mucous membrane.   If there were such a thing as a bronchial
catarrh, characterized by a copious secretion of epithelium in
addition to the formation of mucus and pus corpuscles, similarly
to what is observed on mucous membranes that possess a pave-
ment epithelium, then we ought to find ciliary epithelium, or at
least cylindriform epithelial forms, in greater quantity in the ex-
pectoration.   But ciliary cells are altogether wanting in catarrhal
expectoration, or are present only as isolated cells (Biermer).

With reference to the different formed elements found in
the sputa, we encounter in the first place epithelial cells, and
most usually those of the pavement variety, more rarely cylin-
drical and ciliary epithelium.   The pavement epithelium that
is mingled with the sputa comes mostly from the cavity of the
mouth ; but it may also come from the upper portions of the
air-passages, that is, from the vocal cords.   Cylindrical epithe-

lium, on the other hand, is usually found in relatively small quantity. Ciliary epithelium is also not often found in the expectorated masses. Sometimes it is encountered in unaltered configuration ; sometimes, and that more frequently, after loss of the hair-like appendages ; and sometimes, again, changed to a more or less globular form. But it is always to be borne in mind that ciliary and cylindrical epithelial cells are relatively seldom observed in the expectoration examined during life ; and it is self-evident that the sputum taken from the dead body affords no just conclusion concerning the copiousness of that thrown off during life.

The second and much more important class of formed ele ments found in the sputa, comprises the mucus and pus corpuscles. These pus corpuscles represent nothing else than wandering white blood-corpuscles. According to others, on the other hand, this is not to be regarded as the only source of the pus ; they believe it probable that the pus furnished by the mucous membrane may even be produced, in part, by the endogenous formation of superficial epithelial cells. Mucus and pus corpuscles occur in every sputum, but in exceedingly varying quantity. The richer the bronchial secretion is in pus corpuscles, the less translucent it is. The secretion becomes more opaque with the increased abundance of pus corpuscles, and acquires a more or less yellow or greenish-yellow color. On the other hand, the bronchial secretion is the more translucent the less the quantity of cell-formations it contains.

In addition to the mucus and pus corpuscles, red blood-corpuscles are also often found in the secretion. Crystals of sebacic acid and of margarine, and fungous formations may be designated as further constituents of the bronchial secretions. Crystals of ammonio-magnesia phosphate may also be encountered in decomposed masses of expectoration ; and, less frequently, plates of cholestearine. We will consider the special occurrence of these last-mentioned formations in treating of the symptoms.

The mucus plays the most important part among the amorphous constituents of the sputa. Mucus exists in all sputa ; but the quantity present is naturally very different in individual cases.

Finally, in reference to the condition of the *parenchyma of the lungs* in the different forms of bronchitis, those alterations only of the pulmonary parenchyma come into consideration here which are to be regarded as the immediate consequences of bronchitis, and those which stand in intimate causal connection with it. On the other hand, simple complications of bronchitis, in which the parenchyma of the lungs is involved, are, as a matter of course, excluded from consideration in this place.

Ordinary simple catarrh of the trachea, the larger and the middle-sized bronchi, has, as a rule, no further injurious influence upon the parenchyma of the lungs; and consequently the special parenchyma of the lungs is found intact in this form of catarrh if there are no co-existing complications. It is otherwise, on the contrary, when the catarrh extends into the minuter and minutest bronchial twigs. Under these circumstances there is not infrequently observed a series of further alterations, which occur the more readily because this very form of bronchitis is especially likely to affect individuals already enfeebled. It is especially children, aged persons, and individuals debilitated by any cause whatever, who are attacked by this catarrh of the smaller and the smallest bronchi. In proportion as these smallest bronchi become occluded by secretion, access to the affected alveoli will be impeded. A second danger from the catarrh of the smallest bronchi resides in the fact that the catarrhal inflammation may become extended into the very lung-tissue itself, so that a so-called catarrhal pneumonia becomes superadded to the existing disease.

Buhl[1] justly makes the remark that as there is no mucous membrane in the lung itself, the name "Catarrhal pneumonia" is not well chosen. Although the alveolar wall at its termination is nothing else than the continued inner fibrous sheath (mucous membrane) of the bronchi, it is so very much reduced that it no longer resembles a mucous membrane in anything; its inner enveloping epithelium has undergone such marked alterations of form, becoming squamous, and being spread out in only a single layer, that it can no longer be identified with the bronchial

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[1] Lungenentzündung, Tuberkulose und Schwindsucht.   Zwölf Briefe an einen Freund.   München, 2. Aufl., 1873.

mucous membrane which supports ciliary cells and is composed of several strata. According to Buhl, the disease called catarrhal pneumonia is no pneumonia, but only a capillary bronchitis, a bronchiolitis, in which the lung participates by collateral œdema, atelectasis, local emphysema, and obstruction in consequence of the secretion forced from the bronchi towards individual lobules of alveoli.

Emphysema is to be mentioned as a further, and not infrequent disease of the lung in chronic catarrh. Thus, for example, in severe catarrh of the lower section of the lung, a secondary emphysematous dilatation of the upper section is observed not infrequently. The lack of action due to the partial immobility of the lower section will be compensated for by a vicarious increased activity of the upper section ; in addition to which the severe efforts of cough associated with this bronchitis contributes to this excessive dilatation of individual sections of the lung. The seat and intensity of the emphysematous destruction will naturally bear different relations in different cases, according to the seat and extent of the catarrh. In affections of still shorter duration the changes which occur resemble less an actual emphysema than that condition designated as acute inflation of the lung.

In other cases still further complications with diseases of the lungs are observed, as, for example, collapse of the lung, atelectasis, etc. ; for the more accurate anatomical relations of which diseases we must refer the reader to the special chapters treating of these affections.

Diseases of the *pleura* are but very seldom observed in connection with the affections of the bronchi under consideration. Sometimes small subpleural ecchymoses are found. Inflammatory diseases of the pleura, on the contrary, when occasionally encountered in patients with bronchial affections, are in but distant connection with the latter, or in no connection whatever.

A more intimate relationship is presented between diseases of the bronchi and diseases of the *lymphatic glands* of the lungs and the bronchi. The circumstance that the vessels of the glands mentioned are given off from the bronchial vessels renders it a matter of no surprise that the bronchial glands should frequently

become sympathetically diseased in severe affections of the bronchi. The diseases of the glands that are observed under these circumstances are naturally of varying nature, according to the duration and intensity of the bronchial affection. Sometimes it is but a simple hyperæmia, sometimes a hyperplasia, sometimes a more or less chronic inflammation, with pigmentation, sometimes cheesy degeneration, calcification, and the like.

In the earlier stages of inflammation of the bronchial glands, the glands are found enlarged, the tissue still soft, and of a reddish-gray color, and the surrounding connective tissue hyperæmic. In the later stages the tissue of the bronchial glands becomes denser, and spots of caseous degeneration are disseminated through them, which may finally replace the entire tissue of the gland. In this manner several such degenerated glands may eventually become conjoined into a humped caseous mass. Sometimes, also, there is a partial suppuration of the gland, while cheesy degeneration and calcification are going on in another portion of the fluid.

This participation on the part of the bronchial glands in chronic or acute bronchial catarrh is of no special clinical significance in by far the greatest number of cases. A further series of disturbances results from this complication only in cases in which the bronchial glands have acquired such size as to compress the larger bronchi. With regard to the symptoms thereby produced, we refer the reader to the chapter on bronchial stenosis. A series of further dangerous accidents may be occasioned, also, by the pressure of an enlarged gland upon nervous trunks and blood-vessels, and by the suppuration of either an entire bronchial gland or a part of one, followed by perforation into a bronchus.

Among further alterations which are to be regarded as results of chronic catarrh, those of the *heart* are still to be especially mentioned. Enlargement of the heart, in the form of hypertrophy and dilatation (usually of the right side), is a frequent occurrence in chronic catarrhal inflammations of the bronchial mucous membrane. In the later stages of severe cases the substance of the heart is for the most part uniformly degenerated, its color being at one time of a rather reddish gray, at

another, of a pale yellow. Fatty degeneration of the heart is one of the conditions quite often observed.

Dropsical manifestations are also often observed, and especially when the complication of emphysema exists. Their origin is purely a mechanical one. The dropsy is sometimes confined to the lower extremities, and sometimes more extended upon other regions of the body. The veins are dilated in corresponding measure. The evidences of obstruction are more pronounced in the veins of the hepatic region ; there being at first simple hyperæmic obstruction, then nutmeg-liver, fatty degeneration, partial atrophy of the liver-cells, and so on.

Similar alterations occur in the kidneys. These alterations of the large abdominal glands are analogous to those which are found in insufficiency of the mitral valve, and the like. They are here, as there, the result of venous obstruction. Their occurrence in chronic bronchial catarrhs is in great measure favored by the existence of emphysema of the lungs.

Symptomatology.

Analysis of Individual Symptoms.

Before describing the special course of tracheitis and bronchitis in their exceedingly manifold forms, it appears desirable to present, in advance, a short analysis of the individual symptoms of these diseases. This being done, the description of the individual forms will then follow. In the description of these symptoms only the more important ones, as a matter of course, will be mentioned somewhat in detail.

Alterations of Breathing.—Difficulty of respiration is not observed in every form of catarrhal inflammation of the trachea and bronchi. Well-marked difficulty of respiration is almost always wanting in the milder forms of catarrhal tracheo-bronchitis, because the respiratory interchange of gases is hardly subjected to any important restriction. As a matter of course, the greater the number of obstacles presented to the ingress and egress of the air, the greater must be the resulting dyspnœa. The greater the number of bronchi over which the catarrhal inflammation is extended, the more severe will be the dyspnœa. In

other words, *the degree of dyspnœa is in direct proportion to the extent and intensity of the inflammatory changes in the bronchial mucous membrane.*

To this rule, just announced, that the degree of difficulty in breathing increases in general in proportion to the extent and severity of the bronchitic manifestations, there are numerous exceptions. Thus Traube [1] first directed attention to some further conditions which must contribute to the condition of orthopnœa independently of the impediment to breathing. Traube cites as such, in the first place, a certain grade of consciousness and a certain amount of muscular force. In support of this opinion, he calls attention in the first place to what occurs in typhoid fever and in putrid bronchitis. When full consciousness fails, as in certain stages of typhoid fever, or when the necessary muscular force fails, as so frequently occurs in putrid bronchitis, then every indication of orthopnœa may be wanting, in spite of a considerable impediment to the breathing. From this it follows, as Traube pertinently remarks, that when a patient, who is suffering from considerable impediment to his respiration, has orthopnœa, we should consider it as a better sign than if with the same degree of impediment this symptom were absent.

The dyspnœa seldom reaches in bronchitis that high grade which is so frequently observed in tracheal and bronchial stenosis, to be described later. When the dyspnœa is severe, the patient frequently endeavors to maintain a sitting posture. The reason for this is, in the first place, because the distensibility of the thorax is more complete in this posture than in any other; and, in the second place, because in the sitting posture the patient can put muscular forces in action which otherwise remain unemployed; for example, the pectoral muscles.

In addition to the amount of respiratory obstruction dependent upon the extent and intensity of the catarrhal inflammation, a series of further elements are of important influence in occasioning difficulty of breathing. *Fever*, for example, belongs to this series. It is a fact, long ago clinically established, that a proportionate increase of the number of respirations accompanies elevation of the body-temperature. This clinically established fact has received additional support from the splendid investigations of Ackermann,[2] who first proved experimentally that the number of respirations increased in direct proportion to the elevation of the temperature of the body. In continuing this investigation, the truth of which has been confirmed by various other observers, especially by Rosenthal,[3] myself,[4] and others, Fick[5] has adduced proof that it is the higher temperature of the blood which

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[1] *Traube*, Die Symptome der Krankheiten des Respirations- und Circulationsapparates, 1. Lieferung, 1867, p. 11.

[2] Deutsches Archiv f. klinische Medicin, Bd. II., p. 361.

[3] Zur Kenntnis der Wärmeregulirung bei den warmblütigen Thieren. Erlangen, 1872.

[4] Pflüger's Archiv f. die gesammte Physiologie, V. Bd., and Virchow's Archiv, Bd. LXI.

[5] Würzburger Verhandlungen, 1871, pp. 156–169.

excites the breathing centre to increased activity. It would appear, therefore, that the grade of fever which complicates a tracheo-bronchitis may influence the degree of dyspnœa; and it is thus comprehensible how exceptions to the rule mentioned above may readily occur. It is therefore easy to understand how, in one case, in which there is no fever, only a moderate amount of dyspnœa may exist, despite a severe grade of the bronchial affection; and how, in another case, in which there is a high fever, much severer dyspnœa may exist, despite the relatively less extent and intensity of the bronchial affection. It is well known, too, that at different periods of life, and in different individuals, the capacity for reaction, as regards fever, is very different, even under the same injurious influences. While a pneumonia during middle age is almost always associated with considerable fever, it is by no means a rare thing to encounter pneumonias in persons of advanced age which run their course not only without any special subjective symptoms, but often also without any fever, or with but slight febrile movement. The period of childhood, on the other hand, reacts with considerable fever under slight injurious influences; and thus it is comprehensible how a child often evinces a good deal of fever with a bronchitis of slight extent. In a child, then, there is double ground for dyspnœa: on the one hand, because from the narrowness of the air-passages the insufficiency of a small section is here of much greater significance than in adult life; and, on the other hand, because the fever contributes in no small measure to the increase of the dyspnœa occasioned by the diminution of the respiratory surface.

The points mentioned above—the further discussion of which in this place would carry us too far—will suffice to show why the parallelism between the amount of respiratory obstruction and the dyspnœa must exhibit many exceptions to the rule.

If we investigate more closely the symptom of dyspnœa, as it appears in connection with inflammations of the tracheal and bronchial mucous membrane, we must discriminate different forms, according to the seat and extent of the affection. In the first place, it must be borne in mind that there is a large series of bronchitic affections, which, as a rule, occasion no impediment to respiration whatever. On the other hand, again, a careful observation shows that *the form of dyspnœa may be different* even in those cases in which dyspnœa exists.

As I have shown upon another occasion, on the basis of graphic examinations of the respiratory organs in their various diseased conditions, it is not sufficient to consider dyspnœa simply as a difficulty in breathing, but we must discriminate between three important different forms of dyspnœa—an *inspiratory,* an *expiratory,* and a *mixed* dyspnœa. Biermer and Gerhardt had previously established the division into an inspiratory and an expiratory form of dyspnœa, founded upon simple clinical observation. A positive and certain basis for this division was first assured in the stethographic observations of the respiratory organs in various diseased conditions, as first reported by myself; [1] and also through the pneumatometric investigations

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[1] *Riegel,* Die Athembewegungen. Eine physiologisch-pathologische Studie. Würzburg, 1873; and Deutsches Arch. f. klin. Med., Bd. XI.

of Waldenburg.[1] Without entering more closely into this topic it will suffice
here to make the statement that both methods have accurately demonstrated that
there are some diseases in which inspiration is impeded exclusively or in greater
part—*diseases with inspiratory dyspnœa ;* others in which expiration is impeded
principally—*diseases with expiratory dyspnœa ;* and others still in which both acts
of respiration are more or less impeded, a class which I have designated as *diseases
with mixed dyspnœa.*

It therefore no longer suffices, as has too frequently been the case, to speak
simply of dyspnœa; but the special form of the dyspnœa must always be deter-
mined. If we ask ourselves, however, what are the special characteristics of the
respiratory impediments occurring in the acute and chronic inflammations of the
tracheal and bronchial mucous membrane, it must be borne in mind that here, also,
a series of different forms are observed, according to the special seat of the process
and its extent.

For the solution of this question the subjective difficulties of respiration are of
little interest; deviations in the frequency of breathing, and especially in the form
of the type of the respiration, are, on the contrary, of much greater interest.

That form of respiratory type, which authors have agreed to designate as the
inspiratory form of dyspnœa, is only occasionally observed. As is well known, it
is observed in a very pronounced form in the laryngeal croup of children, and like-
wise in paralysis of the posterior crico-arytenoid muscles. This inspiratory dyspnœa
is observed in all the more considerable constrictions of the trachea, in very much
the same manner as in constriction of the larynx. Whistling, prolonged inspi-
ration, with relatively short and freer expiration, the participation of all the adjunct
inspiratory muscles, inspiratory depression of the epigastrium and lower portion of
the chest, relatively slower breathing, and some other manifestations characterize
this form of pure inspiratory dyspnœa. As is readily comprehensible, even intense
forms of tracheitis are hardly calculated to produce this form of dyspnœa, because,
for the most part, they are not associated with any, at least considerable, diminu-
tion of the calibre of the passage.

In actual stenoses of the trachea, on the contrary, there is frequent opportunity
of observing the pure form of inspiratory dyspnœa. It is not a rare thing to meet
with that form of dyspnœa in which the only anomaly consists in an increased
rapidity in the movements of respiration, while the individual phases of the act of
breathing exhibit no deviation from the normal type, and the auxiliary muscles of
respiration do not participate to any extent in the process of breathing. This form
of dyspnœa, with simple acceleration of the respiratory movements, is observed
with tolerable frequency; relatively more often in the acute forms of catarrhal
bronchitis than in any other.

It is otherwise in protracted catarrhs of the larger divisions of the bronchi,
especially when they are severe. Here, not infrequently, a further form of dyspnœa
is observed, characterized by relatively normal inspiration, with markedly prolonged

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[1] Berlin klin. Wochenschrift, 1871, No. 45.

and impeded expiration. This condition is recognized with greatest distinctness by the graphic method of exploration of the respiratory organs. This variety of breathing, which may or may not be associated with appreciable increase in the number of respirations, corresponds, in a measure, with that form of dyspnœa which occurs in regular emphysema. On closer investigation it is further ascertained that those portions of the thorax which are the chief seats of the catarrh and of accumulations of mucus, participate relatively least in the inspiratory expansion of the thorax. According to a well-known law in physics, then, so much the more air must penetrate into the intact portions of the lungs, and these must be the more severely burdened, sometimes even to the degree of excessive expansion, and even to actual pulmonary inflation. As is well known, in this very way may be explained the occurrence of various forms of the emphysema, which so frequently accompanies and follows chronic catarrh. Thus, for example, in a case of chronic catarrh of the lower portion of the lung, and in cases of considerable accumulation of mucus in the same locality, the upper portion is overtaxed, even to such a degree that there is a complete reversal of the normal type of respiration; in fact the true female type of respiration may be observed in these cases, even in male subjects. Hence in these diseases a certain diagnostic value attaches itself to an investigation into the type of respiration, with reference to the part borne by the individual sections of the thorax. In the higher grades of this affection, the actual asthmatic type of respiration may set in, in which all the auxiliary muscles of inspiration and expiration are brought into overstrained action, and in which an increase of the dyspnœa sets in paroxysmally, with impeded expiration especially. This form is chiefly observed in cases of chronic catarrh, in which the frequent complication of emphysema already exists.

Finally, there are forms in which the breathing is temporarily irregular, so that sometimes marked acceleration of breathing occurs, and then, again, retarded breathing, and so on. This form, which is by no means frequent, is observed especially in the acute catarrhs of young nervous individuals. This form of dyspnœa is also encountered in the bronchitis of children, and is generally considered as an unfavorable prognostic sign. Finally, this irregular, intermittent form of dyspnœa is sometimes observed, also, at approaching dissolution.

In the types just described we have grouped together only those forms of dyspnœa which occur most frequently. It must not, however, be forgotten that there are a great number of especially mild catarrhal inflammations of the tracheal and bronchial mucous membrane, which, in general, occasion no dyspnœa whatever.

Cough.—Cough is to be mentioned as the second symptom, and one of the most important. As is well known, diseases of the tracheal and bronchial mucous membrane are almost constantly associated with cough; and only in very rare cases is the reflex act of cough wanting in these forms of disease. The

cough, too, which is observed in diseases of the parenchyma of
the lungs, must be regarded, in accordance with the present
results of experimental research, as occasioned only by the
simultaneous implication of the tracheal, bronchial, or even the
laryngeal mucous membrane; for no one has yet succeeded, at
least experimentally, in exciting cough by irritation of the
alveoli (Nothnagel, Kohts). For the minuter details we refer
the reader to our previous remarks concerning the production
of cough; we will only recall here the fact, that, as far as the
cough proceeding from the mucous membrane of the trachea
and bronchi is concerned, all the experiments agree in showing
that cough is most vigorous on irritation of the bifurcation of
the trachea, and less active on irritation of the remaining por-
tions of the trachea and of the bronchi. There is by no means
any precise relation between the amount of secretion present in
the trachea and bronchi, and the severity of the cough, as has
been maintained by various authors. On the contrary, the
cough is often the severest just in the first stage of the catarrhal
inflammation, in which hyperæmia and swelling are the most
prominent symptoms. The locality of the irritation is of much
greater importance than the degree of the accompanying hyper-
æmia and swelling.

With reference to the different sorts of cough, two different
forms have long been recognized, based chiefly upon the expec-
toration: a so-called *dry*, and a *moist* cough. It is self-evident
that this division has reference to the secretion discharged by
the cough, and not to the cough itself. The designations "*dry
catarrh*" and "*moist catarrh*," chosen by Laënnec, are there-
fore preferable. A dry cough, or a dry catarrh, is spoken of
when there has been no accumulation of secretion upon the
mucous membrane, so that there is no discharge of secretion
despite severe paroxysms of cough; and also when the sparse
secretion is so viscid and so firmly adherent to the mucous mem-
brane that even severe efforts of cough do not suffice to expel it.
The first of the stages mentioned has also been frequently
designated by the name of so-called *dry swelling of the mucous
membrane*. On the other hand, a moist cough is spoken of in
cases in which a loose secretion, readily detached, lies upon the

mucous membrane, and in those in which this secretion can be readily removed by the succussion of the cough.

In addition to this a further variety of cough has been established. Thus we hear of a so-called *irritative cough*, which is characterized by very severe paroxysms of cough, with but slight or even absolute absence of expectoration. This form of cough, which is distinguished by the disproportion between the severity of the cough and the paucity of the expectoration, is especially observed in the commencing stages of acute severe inflammations of the mucous membrane of the trachea and the larger bronchi. The patients, in these cases, are tortured by the exceedingly severe and frequently recurring irritative cough, in spite of which, however, in most instances, only a small quantity of tenacious mucus is expelled, with the discharge of which the paroxysm reaches its termination, to be succeeded, after a short time, by another in the same manner. Intelligent patients assert, in such cases, that they feel that it is always the same spot which gives occasion to the irritable cough. This spot corresponds most frequently with the point of bifurcation ; but sometimes, also, with the inter-arytenoid incisure.

Many designate the characteristic *spasmodic cough* as a special subdivision, one that represents the highest grade of straining cough. It occurs in the form of exceedingly severe paroxysms, similar to those of whooping-cough, and the paroxysms of cough often reach so high a grade in this form, that marked cyanosis, and even vomiting, coughing of blood, and the like set in.

The most frequent form of cough observed is that in which the cough is relatively slight, the expectoration following it without especial trouble ; in this form, after a few succussions of cough, there always follows a pause free from cough, sometimes of shorter and sometimes of longer duration. This is the form which is most frequently observed in those forms of inflammation under consideration.

The consistence of the secretions of the mucous membrane is of important influence in the production of these different forms of cough. The looser and more rich in cells the secretion is, the more readily it is detached, and the less severe and straining will

the cough be. On the other hand, where the secretion is very viscid and can be detached only with difficulty, severe spasmodic paroxysms of cough readily occur.

Condition of the Skin.—As in many other diseases, so also in those of the tracheal and bronchial mucous membrane, the condition of the external skin is of significance. The results afforded by this indication often yield better information concerning the duration and severity of the affection than is derivable from percussion and auscultation ; and, consequently, they are not without interest in a prognostic point of view. The presence of cyanosis, and the degree it has reached, are here of especially great significance. As in other diseases connected with circulatory disturbances, so also in inflammations of the tracheal and bronchial mucous membrane, the *cyanosis* is hardly ever spread over the entire periphery of the body. For the most part only the slighter grades of cyanosis are observed in the diseases under consideration. The cyanosis undergoes a remarkable increase in the severe paroxysms of cough mentioned earlier.

Cyanosis is encountered most frequently in the later stages of the chronic bronchitis of adults ; a form of disease which, as is well known, is observed with especial frequency in the working classes, and which, in a certain number of cases, may even lead to a fatal termination with the appearance of dropsical manifestations. High grades of cyanosis are frequently observed in those cases especially in which the chronic bronchitis is complicated with emphysema, as is indeed often the case. The characteristic bluish color is not confined to those portions of the body which ordinarily exhibit a somewhat livelier coloration, and which first become affected by the slighter grades of cyanosis, as for example the lips, cheeks, ears, and the like, but the entire visage presents a bluish-red, dull aspect ; the jugular veins are swollen and strongly dilated, and exhibit undulatory or even pulsating movements ; the eyeballs project more strongly ; the nails are bluish-red ; the tips of the fingers are thickened ; and so on. The cyanosis always comes on gradually in these cases, so that its occurrence may be watched, step by step, from its slightest commencement to its greatest intensity. For a certain length of time the circulatory disturbance caused by the fundamental disease is adjusted by a compensatory hypertrophy and dilatation of the right ventricle of the heart. Then, when this compensation becomes insufficient, or when, as sometimes happens, the hypertrophied and dilated ventricle can no longer sufficiently equalize the increased resistance—in consequence of fatty degeneration, for example—the cyanosis rapidly reaches a high grade. In other cases the cyanosis often undergoes a rapid increase, especially in the very acute forms of diffuse bronchial catarrh. Even in the capil-

lary bronchitis of children, cyanosis is quite often rapidly developed, even though of only moderate grade in most instances. In the same manner, in the acute forms of tracheitis, with very copious secretion of mucus, a moderate cyanosis is sometimes observed, which disappears rapidly again with the diminution of the swelling and the secretion, and the consequent increase in calibre of the passages.

In the later stages of chronic catarrh, a state of general dropsy may even occur, the swelling always commencing at the ankles and then extending gradually upwards.

With reference to the *secretion of sweat* in bronchitic patients, a general outbreak of perspiration as a sort of critical phenomenon, attended with a reduction of temperature, occurs only occasionally.

Night-sweats, which are so frequently observed after midnight or towards morning in tuberculous patients, occur only occasionally and temporarily in bronchitis.

On the other hand, the occurrence of perspiration upon limited sections of the body, especially upon the head, neck, and upper portions of the chest, is observed rather more frequently, especially in intense forms of bronchitis associated with severe dyspnœa.

Condition of Nutrition.—According to the severity and duration of the inflammatory process, according to its extent, and according to the more or less active febrile movements associated therewith, the general constitution and the nutrition are sometimes more or less involved. The nutritive condition at the time of the commencement of the disease, as well as the age of the patient, is of great significance. Thus it makes a great difference whether the affection occur in earliest childhood, in robust adult life, or in extreme old age.

In the simple acute bronchial catarrhs of adults, especially those associated with but little or no fever, nutrition suffers either very slightly, or not at all, in the majority of cases. It is otherwise in children and in aged subjects, in whom severe catarrh is apt to involve the general constitution.

Chronic catarrhs, in general, also may exist for a long time without special injury to the general system. It is only at a very late stage of the trouble, when considerable evidences of obstruction have become manifested, that the nutrition suffers to

any great extent.   In this very particular there is an important
contrast between the chronic tuberculous process and simple
bronchitis, inasmuch as the former malady is always associated,
even at an early period, with marked impoverishment of the
blood, and severe disturbance of the general health.

This slight participation of the general system in chronic
catarrh is the cause also why cyanotic and dropsical manifesta-
tions are observed more frequently than in tuberculous processes,
in which the impoverishment of the blood is unfavorable for the
production of obstructive manifestations of any consequence.

Expectoration.—The expectoration in catarrhal inflammation
of the trachea and bronchi varies, in individual cases, not only
in reference to quantity, but a great deal also in reference to
quality.   Its volume may vary from quantities hardly worth
mentioning to very considerable masses.   In individual cases and
in certain stages expectoration may fail entirely for a longer or
shorter period.   This absence of expectoration may have its
origin in different causes.   It may be that the mucous membrane,
as a whole, furnishes secretion only sparingly or not at all.   In
other cases the patient may swallow the sputa, as, for example,
is the rule in children.   In other cases, again, the secretion,
especially when very viscid and located in the smallest bronchi,
adheres to the parts, and here often even very forcible efforts of
cough, continued for a long time, may either fail to remove it,
or remove it only with difficulty.

Frequently enough the expectoration does not simply repre-
sent the secretion of the diseased tracheal and bronchial mucous
membrane, but many other constituents become mixed with it in
its transit through the air-passages to the mouth, such as the
contents of the pharynx, mouth, and the like.

In passing to the description of the more important characters
of bronchitic sputa, we will follow in the main the divisions
made by Biermer in his admirable account of bronchial diseases,
and in his valuable monograph on the expectoration.

Biermer distinguishes the following varieties of expectoration :
1. The viscid, mucous, transparent sputum, poor in cells, which corresponds with
the first stage of acute bronchitis, and which is characterized by its slight amount of
cellular elements as well as by its great viscidity.   This expectoration (usually

though inappropriately designated as *mucous sputa*) is, as a rule, expelled with severe efforts of cough. It is always viscid and tenacious; often so tenacious and so adherent to the vessel into which it is expectorated, that it does not flow out of it even when placed upside down. It is colorless, semi-translucent, in part vitreous, and grayish-white, and not infrequently air-bubbles are copiously mixed with it. This increased amount of air is explained by the severe efforts of cough which often precede the detachment and expulsion of the viscid masses of mucus. The severer and more protracted the cough, the more frothy is the expectoration. This severe and straining cough is also the cause why small quantities of blood are sometimes mixed with the expectoration.

Microscopic examination reveals very few formed constituents: mucus and pus-corpuscles, and isolated cells of ciliary epithelium. Not infrequently squamous epithelium also is mixed in with the sputa.

This sputum, which is readily confluent in the spit-cup, and corresponds with the initiatory period of tracheo-bronchitis, represents the so-called *sputum crudum* of the older authors. The most important characteristic of the expectoration of this first period is, that the secretion is relatively poor in cellular elements. With the further progress of the process more and more of the cellular elements become freed; and with this increased production of cellular elements the culmination of the process is passed.

2. The richly cellular, non-translucent mucous expectoration of Biermer consists chiefly of mucus and pus cells. This form has been designated by most authors by the appropriate name "*muco-purulent sputa*." It is very closely connected with the form first described, the "*mucous sputa;*" it results immediately from it, and indicates the second stage of acute catarrh. Even in chronic bronchial catarrh this form of expectoration is frequently enough observed. The appearance of the richly cellular secretion coincides with the decline of the inflammatory hyperæmic manifestations and the relief to expectoration progresses in the same ratio in most instances.

The older authors named this sputum "*coctum*," in contrast to the *sputum crudum*. With the increased admixture of cellular elements the viscid, adhesive, transparent secretion of the first stage of acute catarrh becomes thicker, more yellow, and less translucent. Microscopically examined, it is found to contain mucus and pus corpuscles chiefly; but squamous and cylindrical epithelium, etc., may be mixed with it as more inconstant constituents. The proportion of mucus to pus is naturally a variable one in individual cases and at the different periods of the catarrhal inflammation. In proportion, however, as the increased production of the cellular elements preponderates, there is a gradual transition to a further form which we

3. Designate as *purulent sputa*, chiefly, or according to Biermer, as *muco-purulent* and *puriform sputa*. In contrast to the form just described, this form of sputa is characterized by being chiefly composed of pus cells. Pure purulent sputa are hardly ever expelled in bronchitis, though seen in abscesses of the lung and in purulent pleuritis with perforation into a bronchus.

While in the sputa previously described the mucous constituents still preponderate, there is also a mucous admixture in this form, but pus cells form its principal constituent. The appearance of these sputa differs considerably, also, from that previously described. It resembles very much the ordinary pus from connective tissue, only that in consequence of the admixture of mucous constituents the color does not represent that exquisite creamy character which is presented by pure connective-tissue pus. This form of sputa is especially observed in the chronic forms of bronchitis. Microscopic examination shows numerous pus corpuscles as the predominant formed element, then epithelial cells, in part in a state of fatty degeneration, and so on. Elastic fibres are never found in the expectoration in simple bronchitis.

If a large series of these muco-purulent sputa are examined in a spitting-cup, a number of variations will be exhibited in individual cases. With reference to these different conditions of the sputa in the spit-cup, Biermer has distinguished three types of muco-purulent sputa :—

a. Greenish or yellowish clumps of muco-pus, in a sero-mucous fluid; one portion of the clumps may remain floating on account of the admixture of air, while the remaining portions sink to the bottom.

b. The muco-purulent sputa have run together in the spit-cup. These masses separate after a while into several layers; the heavy, purulent portions sink to the bottom; above this sediment there is a sero-mucous layer, in which some shreds of mucus containing bubbles of air are suspended; upon the surface there is considerable froth. This broncho-blennorrhœic secretion is often expelled in considerable quantity; its odor is often fetid in a high degree.

c. Roundish, nummular sputa, which lie separate beside each other in the spit-cup.

The first two forms of sputa occur frequently enough in chronic bronchitis. The second form described is observed, especially in the bronchial blennorrhœa, associated with dilatation of the bronchi; but, as shown by Traube,[1] it is by no means peculiar to this form of disease; it is also observed in the same manner in fetid bronchitis, to which we shall recur more particularly later. Concerning the third form, the nummular sputa, it is true that it is most frequently encountered in tuberculous cavities. The spherical or coin-like form is the more definitely marked the less the amount of fluid mingled with the sputum; where this fluid is abundantly present, the nummular sputa become confluent with the mucus after remaining for some time in the spit-cup. On the other hand, it is not proper to regard nummular sputa as the product of a cavity only. Biermer has also mentioned that he has observed this form of sputa a few times in simple chronic bronchitis.

4. A sero-mucous sputum, which is characterized by its thin, thready consistence. It is frequently copiously mixed with air-bubbles, so that a complete layer of froth caps the surface of the expectorated mass. The quantity of this expectoration is often very considerable, so that an actual bronchorrhœa exists. It is observed

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[1] Deutsche Klinik, 1861.

most frequently in the chronic forms of bronchitis; but there are also acute cases of such bronchorrhœa, although they are infrequent.

Concerning the *chemical composition of the sputa* we are especially indebted to the minute investigations of Bamberger.[1] He analyzed the ashes from the sputa obtained in chronic bronchial catarrh, bronchiectasia, chronic pulmonary tuberculosis, acute tubercular infiltration, and pneumonia in the characteristic inflammatory stage, and at the period of resolution. The results of these investigations acquire so much the greater interest from the fact that we can compare them with the results of analyses of the lungs. We cannot enter here into any special presentation of the numerous interesting results reported by Bamberger, results obtained by the analysis of the constituents of the ashes of the sputa; but we shall content ourselves with a short comparison of this analysis with that of the ashes of the lungs as obtained by Kussmaul [2] in his well-arranged investigations.

It thus appears that the constituents of the ashes of the sputa and the lungs are as follows: Chlorine, sulphuric acid, phosphoric acid, potassa, soda, lime and magnesia, oxide of iron and silicic acid; but the quantitative composition of the ashes of both differs greatly. The difference is especially with reference to the chlorine, the phosphoric acid, the potassa, the oxide of iron, and the silicic acid; while soda, potassa, lime, and magnesia appear in both ashes in about the same percentage, and the sulphuric acid is a characteristic only in the sputa of pneumonia.

While, according to the investigations of Kussmaul, phosphoric acid plays the preponderating rôle in the ashes from the lungs, and the chlorine recedes in proportion as the lung-tissue is free from infiltrated exudation, tubercle, and bronchial secretion, we see the phosphoric acid remain behind the chlorine in the ashes of the sputa. In the ashes of the sputa, phosphoric acid was present in the maximum of 14 per cent.; in those of catarrhal and purulent sputa, there was from 10 to 13 per cent. The ashes of the lung, on the contrary, constantly contained a very large amount of phosphoric acid, from 36 to 48 per cent.

The different proportions of potassa in the ashes of the lung and in those of the sputa are worthy of remark. Potassa plays a very subordinate rôle in the lung, whereas it is found in the proportion of from 16 to 24 per cent. in the ashes of catarrhal and purulent sputa. The proportion of soda, on the contrary, appears to differ much less in the two sorts of ashes.

Oxide of iron, again, is found always in exceedingly small amount in the ashes of sputa, while it always forms a considerable proportion in those from the lung.

From a comparison instituted by Bamberger concerning the chemical composition of pus and the puriform sputa, it is shown that pus contains a greater quantity of organic constituents and organic salts than sputa; while, on the contrary, there is almost always found a like proportion of soluble and insoluble salts, among which the earthy phosphates play the chief rôle, though silica seems to be entirely absent in pus.

[1] Würzburger med. Zeitschr., Bd. II., 1861., p. 333.

[2] *Kussmaul*, Aschenbestandtheile der Lungen und Bronchialdrüsen, Deutsches Archiv f. klin. Med., Bd. II., p. 113.

The views of Laycock[1] concerning the cause of the foul odor of the sputa in fetid bronchitis are worthy of consideration. In three cases of putrid bronchitis he had the sputa examined by Gregory, who detected methylamine, butyric and acetic acids, as the cause of the foul odor. He believes that the presence of volatile fatty acids in the sputa will not serve to distinguish fetid bronchitis from gangrene of the lung.

The reports of Petters[2] concerning the chemistry of broncho-blennorrhœic sputa, are also worthy of consideration.

Petters found more mineral constituents (2. 42. 43 per cent.) in broncho-blennorrhœic sputa than were found by Biermer and Bamberger. The sputa contained 6.0772 per cent. of organic substances.

So much for the chemistry of the sputa. We will take opportunity to recur to the special peculiarities of the sputa when describing the individual forms of disease.

Thoracic Pains—Disturbances on the Part of the Nervous System.

Thoracic pains are by no means infrequent in both acute and severe chronic catarrhs. The patients, especially in acute catarrhs of the trachea and of the larger bronchi, often complain of dryness, tickling, and burning, downwards along the trachea. The characteristic thoracic pains are located most frequently at the sternum, sometimes more at its upper portion, as in simple tracheo-bronchitis, and sometimes farther down. Quite often, too, the pain extends to the thoracic muscles upon both sides. The epigastrium also is sometimes painful in bronchial catarrhs. This epigastric pain has its seat most frequently in the muscles, and is chiefly occasioned by the severe efforts of cough. This epigastric pain is not to be confounded with that which occurs in very late periods of chronic bronchial catarrh, and which is referable to the hyperæmic and enlarged liver.

In the majority of cases in which pain is complained of in the locality mentioned, palpation of the spot does not bring out any special pain. Only occasionally is pressure painful at this point, especially in those cases in which there have been slight ruptures of muscles or hemorrhages between the individual muscular

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[1] Med. Times and Gaz., May 16, 1857, p. 479.
[2] Prager med. Wochenschr., 1864, Nos. 4 and 5.

fibres in consequence of the severe succussions of cough. These two accidents are confined chiefly to the expiratory muscles.

Lateral pains, stitches in the side, are less frequently observed. They are most frequently located in the lower lateral section of the thorax. If there is no complication with inflammatory affections of the pleura, these stitches in the side are of but slight intensity and usually cease spontaneously after a short time.

In addition to the thoracic pains mentioned, actual nervous symptoms are in the main rarely observed in the different forms of tracheitis and bronchitis. They are in part only the result of the fever, and cease again after it has passed away. In part also they depend upon the secondary circulatory disturbances occasioned by the bronchial affection.

A sensation of chilliness, with which acute bronchitis is not infrequently ushered in, is to be included among the nervous manifestations associated with the fever. An important difference between this and certain other affections, pneumonia in particular, lies in the fact, as already advanced by Niemeyer, that the chill observed in acute febrile bronchitis is usually repeated several times, while in pneumonia a repetition of the chill is among the rarest exceptions. In by far the greatest number of cases, however, there is not a characteristic rigor, but rather in most instances a slight shiver, a sensation of being cold, or an excessive sensitiveness to changes of temperature. These slight manifestations of chill are observed towards evening especially, that is, at the time of the exacerbations of temperature. As a rule, they gradually pass away after a short time.

Headache requires special mention among the remaining nervous manifestations. Slight pains in the head, slight vertigo, and the like, are not infrequently complained of, especially at the commencement of acute bronchitis. Their origin may be different in different cases. Thus, in acute febrile bronchitis, a portion of these nervous manifestations may be at once attributed to the fever. On the other hand, in the later course of chronic bronchitis, after considerable evidences of obstruction, such as cyanosis, dropsy, and other like symptoms, have become developed in consequence of the disturbed relations of the circu-

lation, these nervous symptoms are not infrequently encountered in direct connection with the disturbed relations of the circulation. In like manner complaints of pains in the limbs at this period are by no means infrequent, but, at the same time, they are not of any great importance.

The occurrence of severe neuralgic headache is mentioned by some observers. Thus Rilliet and Barthez describe a severe supra- and infra-orbital headache which occurs paroxysmally in children affected with severe bronchitis, and they also make mention of eclampsia as an initial symptom of infantile bronchitis in rare cases.

Soporific manifestations are but rarely observed in the diseases under consideration. In the acute form of bronchitis they are encountered with most frequency in old people, in whom, as is well known, an intense bronchitis is always a serious affection, and also in very small children. In the case of children they are frequently preceded by delirium, and under certain circumstances even by mild convulsions. In children these cerebral symptoms may become developed to such a degree that the possibility of mistaking them for evidences of tuberculous meningitis, is not out of the question. On the other hand, again, in the later stages of chronic catarrh, when cyanosis, dropsy, and similar symptoms of disturbance of the circulation have become more developed, it is not unusual to encounter a certain hebetude of the sensorium, great drowsiness, and apathy. Even mild delirium is sometimes observed in these cases.

Impairment of sleep is by no means an infrequent occurrence. In many cases, indeed in the majority of cases, this is due to the severe paroxysms of coughing ; but in many cases the fever and other causes may cooperate to a certain extent.

Disturbances of the digestive organs frequently accompany the severer forms of acute bronchitis. As in all affections associated with fever, so also in these forms of acute bronchitis, there is not infrequently *loss of appetite*, a more or less coated tongue, increased thirst, and more symptoms of the like character. *Vomiting* is but rarely observed, and then most frequently in the bronchitis of children. In the acute forms of disease these disturbances of the digestive organs usually subside after a few days. It is otherwise in the chronic forms of bronchitis, espe-

cially at an advanced period when secondary hypertrophy of the heart, intense cyanosis, dropsical manifestations, and other sequelæ of the same kind have become established. At this stage, disturbances of the digestive organs are by no means infrequent. The appetite, then, is often more or less impaired ; sometimes there is great disposition to constipation ; in other cases, again, the stools are more diarrhœal in character ; and sometimes, again, constipation and diarrhœa interchange with each other. The origin of these disturbed intestinal functions lies in nothing else than the manifestations of obstruction which become extended upon the intestinal tract. On the other hand, in the milder forms of both acute and chronic bronchitis, gastric disturbances fail, as a rule, altogether, or exist in but slight intensity.

Condition of the Urine.—The urine by no means always exhibits alterations in the diseases under consideration. Sometimes these alterations are completely absent, sometimes, again, they are present in a tolerably high degree.

Here, too, as in the occurrence of many of the symptoms mentioned, the accompanying fever plays an important rôle. The alterations which the urine undergoes in fever, and also, therefore, in bronchitis accompanied with fever, are, as is well known, so conspicuous, that even the older pathologists spoke in an inaccurate manner of " febrile urine." We may consider as the ordinary, though by no means characteristic, peculiarities of all febrile urine, diminished quantity, high specific gravity, dark-red coloration, and increased proportion of urea.

But we see on the other hand, as Traube[1] says, in the course of diseases of the respiratory apparatus, a condition of urine appear without fever, very similar to that occurring in fever, a condition which we frequently have opportunity to observe in cardiac diseases also. This sort of urine is not infrequently observed in diffuse bronchial catarrh. Like the febrile urine, this also frequently shows a yellowish-red sediment of uric acid salts. Sometimes, especially when severe manifestations of obstruction, cardiac hypertrophy, dropsy, and similar consecutive disturbances have become developed, the urine contains, in addition, albumen, tubular casts, and the like. On the other hand, no important deviation in the condition of the urinary secretion is observed, for the most part, in the milder forms of tracheobronchitis, and in diffuse bronchitis, whether acute or chronic.

Febrile Symptoms.—Fever is by no means a constant attend-

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[1] Die Symptome der Krankheiten des Respirations- u. Circulationsapparates, 1. Lieferung, 1867.

ant on bronchial catarrh.   There are cases of bronchitis with
which fever is associated, and others in which there is no fever.
In general it may be stated as a rule that acute bronchitis is
often associated with fever, which is usually but slight, and is
present as a rule only at the commencement.   The course of
chronic bronchial catarrh, on the other hand, is usually unat-
tended with fever ; it is only at times, as in sudden exacerba-
tions of chronic catarrh, that its course is also interrupted by
slight febrile movements.

No certain rules can be established concerning the occurrence of febrile move-
ments under the influence of acute bronchitis.   In cases of bronchitis of equal
severity we see no fever at all in some instances, and in others moderate or tempo-
rary, or even severe fever.   Age, constitution, general condition of strength, and
other similar factors are of influence here.   Thus *the acute bronchitis of children is
usually associated with fever*, the fever being more intense the greater the number
of bronchial twigs involved.   *Long continued and intense fever is observed chiefly in
capillary bronchitis, and in the catarrhal pneumonia of children.*   On the other hand,
the bronchitis of adults usually occurs with but little fever, and often even without
fever at all ; and when fever is present in adults at the commencement, it usually
subsides entirely in the course of a few days.   The bronchitis of the aged also fre-
quently enough runs its course without fever.

Lebert,[1] on the ground of his numerous statistical compilations, comes to the con-
clusion *that fever is absent in almost one-half of all cases (all the forms of bronchitis
being taken together)*.   In many cases a catarrh runs its course without fever, so long
as only the coarser bronchi are affected.   Fever suddenly occurs later, on the other
hand, as soon as simple bronchitis passes into diffuse bronchitis, or into bron-
chiolitis.

*There is no determinate type of fever in the catarrhal affections of the bronchial
mucous membrane.*   Wunderlich[2] has determined, for catarrhs of the mucous mem-
branes in general, that they exhibit no typical relation concerning the tempera-
ture in general, and the same holds good also in reference to bronchial catarrhs.
In many cases there are only somewhat greater fluctuations than in the healthy con-
dition ; the temperature rising in the evening beyond the normal degree, or to that
of the subfebrile or moderately febrile condition.

Here and there, again, irregular elevations of temperature are met with, which
are usually associated with fresh injurious influences, or with incidental exacerba-
tions of the catarrhal affection.   *The severer a case is, and the higher the fever, the*

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[1] Klinik der Brustkrankheiten, 1874.

[2] *Wunderlich,* Das Verhalten der Eigenwärme in Krankheiten, 2. verm. Aufl.   Leip-
zig, 1870.

less marked usually are the remissions. The character of the fever is usually that of a moderate remittent (Lebert).

Concerning the lysis of the affection, it is still to be remarked *that there is not, here, for the most part, as in pneumonia, a sudden fall of temperature down to the normal degree, or below it, but that the lysis usually occurs slowly and gradually.*

The course of the temperature is in no sense typical, or characteristic of the disease. The temperature in almost every instance, as I can substantiate by my own numerous observations, reaches but a moderate height, between 38° and 39° C. (100°–102.5° F.). Temperatures, therefore, of 41° C. (106° F.) and upwards, as are reported to have been found by individual observers in acute bronchitis, must awaken suspicion as to some complication, or else be designated as unusually exceptional.

Sweating is absent in many forms of bronchitis. In the acute forms the skin is usually inclined to be dry the first few days, though later there may be a secretion of sweat, sometimes copious and sometimes very slight. No definite regularity exists here in reference to the occurrence of perspiration. Slight sweatings are sometimes observed in the later stages of chronic bronchitis. In the terminal stage, also, both of the acute and the chronic forms, an outbreak of sweat is sometimes observed, but it occurs in these instances as part of the phenomena of collapse.

Nothing certain is known concerning the *nutritive changes* which take place in the different forms of bronchitis. It is a known fact that children are often considerably reduced in their nutrition in consequence of capillary bronchitis. Inasmuch as fever exerts the greatest influence on these changes, and inasmuch as bronchitis is more apt to be associated with severe fever in children than in adults, the comprehension of this fact in general is not attended with any difficulty. Adults, on the contrary, as a rule, suffer no material diminution of vigor, even in bronchitis lasting for years.

The condition of the *activity of the heart*, and of *the pulse*, is nearly parallel with that of the body temperature, as in the majority of the febrile diseases. Cases without fever, therefore, in general present no important acceleration in the frequency of the contractions of the heart. The number of pulsations, on the other hand, increases in close proportion with the elevation of the body heat. As daily practice shows, there are numerous exceptions to this rule, which has been established clinically as

well as experimentally, and the disease in question furnishes
examples in sufficient number. Thus, in the capillary bron-
chitis of children especially, a very considerable acceleration of
the pulse is exhibited, which often bears no relation to the slight
or moderate increase of bodily heat. Of much rarer occurrence
is the reverse abnormal relation, in which there is observed
a relative diminution in the frequency of the pulse, with in-
creased temperature.

Concerning the remaining characters of the pulse there is no
special characteristic or constant alteration. In the beginning
of an acute bronchitis, especially where it is associated with
fever, the pulse is as a rule, full and tense, and even hard; and
in the further course of the disease, and chiefly in severe forms
which influence the general health a good deal, it becomes weak
and small.

Irregularity in the action of the heart comes on especially in
the later stages of chronic bronchitis, when fatty degeneration
begins to be developed in the hypertrophied and dilated right
ventricle, which has become thus affected in consequence of the
disturbed conditions of the circulation. The irregularity and
feebleness of the pulse, which are not infrequently encoun-
tered in the terminal stage of chronic bronchitis, are therefore
always to be considered as unfavorable manifestations.

Symptoms furnished by Physical Exploration.

The results of physical exploration, in the restricted sense of
the phrase, are of especial and much greater importance than
the symptoms already discussed.

In the first place, as far as *inspection* is concerned, it reveals,
according to the form and extent of the catarrh, sometimes more
marked and sometimes slighter deviations from the normal type
of breathing; for special details of which we refer to the remarks
already made. Of these deviations two are chief. The first is in
the reciprocal relation between inspiration and expiration,
which is most frequently disturbed in such manner that the
expiration is impeded while the inspiration follows without
special embarrassment. When expiration is prominently ob-

structed, it must, from obvious reasons, be compensated for principally by two methods: first, by increased expiratory force through the assistance of the auxiliary expiratory muscles, as is evinced in these cases by the strong development of those muscles; second, by increased duration of the effort. Inasmuch as a considerably longer time is then devoted to expiration than is normally requisite, the expiratory obstacle is overcome to a certain degree. This abnormal relation between inspiration and expiration is therefore, on the one hand, a valuable diagnostic aid, which facilitates our judgment as to the nature of the respiratory disturbance, and, on the other hand, a good compensating medium.

The second deviation from the normal type of breathing is evinced by the *abnormal action in certain individual sections of the thorax with diminished action in other sections.* As the effort of the lung is to constantly take in about the same quantity of air, if the penetration of the air is impeded to a greater degree in certain sections of the lungs and the bronchial tubes, an increased penetration takes place in other sections, in those which present no obstacle to the entrance of the air, or present the least obstacle relatively. This disproportionate labor of individual sections of the thorax in cases in which the entrance of the air to certain sections of the bronchial tract is impeded, explains, at least in part, how origin is given in chronic bronchial catarrh to one of the most frequent causes of pulmonary emphysema. Sometimes, however, in chronic bronchial catarrh, and chiefly in its intense grades, we see this irregular labor of the different sections of the thorax manifested in a very marked manner. It is observed especially in cases in which numerous bronchial tubes are occluded with secretion in such a manner that little or no air can penetrate into them and into the alveoli to which they lead.

In other cases, not few in number, there is no deviation at all from the normal type of respiration; while in others, again, acceleration of the respiration is the only abnormal deviation observed.

Spirometry furnishes no special indication in the different forms of bronchitis. Apart from the defects connected with the

method in general, into the closer consideration of which we cannot enter, spirometry is hardly of any special diagnostic value as a simple measure of the vital capacity in the diseases under consideration. The great value of spirometry does not so much reside in the absolute figures obtained at any one time, as in the comparison of a continuous series of figures obtained at different periods.

In mild cases of bronchial catarrh, the diminution of vital capacity is very slight, or there may be none whatever. On the other hand, in intense diffuse catarrhs, or in chronic catarrhs of long continuance, especially when they are associated with emphysema, the diminution of vital capacity, in most instances, is not inconsiderable.

A more important method of examination in the diseases before us is presented, as it appears to me, in the physical method of exploration introduced by Waldenburg[1] and denominated *pneumatometry*. By means of pneumatometry Waldenburg was first enabled to detect *an expiratory insufficiency of the lung in chronic bronchial catarrh*,[2] analogous to that found in emphysema. He found a more or less considerable diminution of the positive force of expiration as exerted upon the manometer. In contrast to this, tuberculosis exhibits an inspiratory insufficiency, that is to say, a diminution of the inspiratory suction on the manometer. Unfortunately, the method, as I can verify by numerous personal experiments, presupposes some practice and tact on the part of the patient, without which errors may very readily occur. As verified by the investigations of Eichhorst[3] and one of my own pupils,[4] the expiratory insufficiency always appears to be a constant characteristic of chronic catarrh, as of emphysema, and thus can be utilized as an important diagnostic aid in distinguishing the affection from tuberculosis, which at its commencement is already associated with inspiratory insufficiency.

The results obtained by the pneumatometer are in complete accord with those that I have obtained by means of *the graphic method of investigation*, undertaken with my simple and double stethograph,[5] in individuals laboring under chronic bronchial catarrh.

Here also it is distinctly shown that it is the expiration which is especially impeded. According to the graphic method, this is marked by an elongated expi-

[1] Berlin. klin. Wochenschrift, 1871, No. 45.

[2] In health, the force of expiration always exceeds that of inspiration, as Waldenburg has shown by numerous experiments.

[3] Deutsches Archiv f. klin. Medicin, Bd. XI., Heft 3, p. 268.

[4] *Lassar*, Zur Manometrie der Lungen. Inaug. Dissert. Würzburg, 1872.

[5] Deutsches Archiv f. klin. Med., Bd. X., p. 124; and *Riegel*, Athembewegungen, mit 12. Tafeln. Würzburg, A. Stuber, 1873.

ratory arm of the curve, in which, from obvious reasons, the last portion of the expiratory part of the curve must exhibit the greatest deviation; that is to say, the last portion of the expiratory arm of the curve is accomplished with the least relative speed. Slight catarrhs, on the contrary, as has also been shown by my graphic investigations, exhibit no important deviation from the normal form of the respiratory curve. The examination with the double stethograph is especially instructive in such chronic catarrhs, because it exhibits in the sharpest manner the unequal labor of individual sections of the thorax already mentioned.

Percussion is of little value in the diseases in question. In the majority of cases it does not show any variation from the normal resonance, inasmuch as the pulmonary parenchyma proper is unaltered. Where the percussion sound exhibits any alteration, it is always evidence of complications with lung affections. It is especially capillary bronchitis, with its secondary affections, collapse of the lung, catarrhal pneumonia, and the like, which produces alteration of the percussion sound. The so-called catarrhal pneumonia, which is so frequently developed from a capillary bronchitis, is, as one of the most frequent complications of bronchitis, also a frequent cause of alteration in the percussion sounds.

A further cause of modification of the sound in bronchitis is furnished in the not infrequent consecutive distention of individual portions of the lung; the occurrence of which is chiefly favored by the severe efforts of cough associated with the affection. This consecutive distention takes place most readily at the edges of the lungs, and in their upper portions. The continuance of the cause may gradually develop a characteristic emphysema out of this acute distention of the lung.

As is evident from what has been said, all modifications of the percussion sound which are observed in the different varieties of bronchitis, do not depend upon the disease itself but upon complicating diseases of the pulmonary parenchyma.

In contradistinction to percussion, the results furnished by *auscultation* are of greater moment; especially the different varieties of *râles*, which occupy the first rank. Their absence by no means indicates that the tracheal and bronchial mucous membrane is completely intact; but their existence must be considered in a measure as pathognomonic evidence of the diseases

in question ; because, whenever they are observed they almost
always indicate disease of the bronchial mucous membrane.

The accurate determination of the *characters of the rales* is
of especial importance, because we can determine thereby the
special sort of alteration existing in the bronchial tubes.   Thus
the long-used distinction between *moist* and *dry* rales has an
important significance.   The former are due to the movement of
thin liquid products in the trachea and bronchi, and the latter
are due to the friction of the current of air against the swollen
mucous membrane of the bronchi, and to the presence of very
viscid products.   Dry rales indicate, therefore, more or less con-
siderable swelling of the mucous membrane, and eventually the
presence of small quantities of very tenacious fluid in the
bronchi.   These dry rales have been further distinguished from
the sonorous, sibilant, and whistling sounds, in which nothing
like a real rale can be any longer perceived.   According as these
latter exist in the larger and medium-sized, or in the smaller and
smallest bronchi, they are designated as sonorous, and as sibi-
lant and whistling sounds.   All these sounds, but those occur-
ring in the larger bronchi especially, may, under certain circum-
stances, be also detected by *palpation* with the open hand laid
upon the chest.   The sensation produced is technically known
as *fremitus*.

The so-called *moist rales*, on the contrary, have an essentially
different significance.   Their existence shows that fluid secre-
tion is present in the bronchi.   They are especially significative
of the breaking of bubbles, but they may also possess very dif-
ferent characters.   Sometimes they are audible only during
inspiration, sometimes only during expiration, and sometimes
during both acts of respiration.   According to the quantity of
fluid present in the bronchi these rales are sometimes more
copious, and sometimes more scanty, provided that the perme-
ability of the bronchi is not obstructed by plugs of mucus.   On
the other hand, the intensity of the rales does not depend only
upon the copiousness of the fluid present, but also upon the
depth of the respirations, the diameter of the bronchi, and the
greater or lesser distance of the affected bronchi from the surface
of the thorax.

The determination whether the râles are due to *large, medium-sized* or *small bubbles*, is of especial importance, inasmuch as the seat and extent of the affection may be thereby determined. Thus, from the extent of the râles and from the special character of the bubbles—whether large, medium-sized, or small,[1] conclusions can be drawn as to the extent of the catarrhal inflammatory affection, and also as to its seat in the larger, medium-sized, or minute bronchi. It must not be forgotten that one or another portion of the bronchial tract may be completely occluded, at least temporarily, by mucus and the like, under which circumstance, as a matter of course, the necessary conditions for the existence of the sounds do not prevail. In the same manner an alteration in the nature of the râles, even within a very brief period, is to be expected as a matter of frequent occurrence.

Alteration in the characteristic *respiratory murmur* is to be mentioned as a further auscultatory manifestation in bronchial catarrh. While the respiratory murmurs are soft and smooth in the normal effort of respiration, they often become harsh and shrill in catarrhs of the bronchial mucous membrane, in consequence of the increased friction of the currents of air upon the swollen membrane. The shrill and harsh breathing will be heard over a greater or less surface according to the extent of the catarrh. A shrillness, and at the same time a prolongation, of the expiratory murmur is frequently associated with this harshness of the vesicular breathing.

Prolonged expiratory murmur is observed with especial frequency in chronic catarrhs, particularly those which are complicated with asthma and emphysema. This prolonged expiration always indicates that there is some obstacle preventing the egress of the air. For this reason it is encountered in almost all severe catarrhs of the bronchial mucous membrane, and especially in diffuse chronic bronchial catarrh.

The harshness of the expiratory murmur usually increases

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[1] We cannot enter into a description of the special mechanism of the production of the râles and the different theories that have been proposed regarding this question. We refer, on this point, to the manuals and treatises on percussion and auscultation, especially those of *Scoda, Gerhardt, Guttmann, P. Niemeyer, Wintrich, Seitz,* and others.

proportionately with its prolongation.   It is due to the friction
of the current of air upon the swollen mucous membrane, and is
therefore likewise a valuable symptom of bronchial catarrh.

In addition to the anomalies of the respiratory murmurs
already mentioned, there is not infrequently a feebleness of the
murmur in bronchitis.   Such feebleness may be due to super-
ficial and light breathing on the part of the patient, but there is
another cause which is much more important and frequent,
namely, occlusion or partial obstruction of the bronchi by mucus
and the like.   With the removal of these plugs of mucus by
coughing, the normal respiratory murmur returns.   The swell-
ing of the mucous membrane alone does not suffice, as a rule, to
produce any considerable feebleness or a failure of the respi-
ratory murmur.   On the other hand, the normal respiratory
murmur may also appear modified from being obscured by the
intensity of the contiguous murmurs, especially the moist rales.

SPECIAL FORMS OF TRACHEITIS AND BRONCHITIS.

I. *Acute Tracheo-bronchitis ; Acute Catarrh of the Trachea and Larger Bronchi.*

The diseases of the mucous membrane of the trachea, as
already remarked in our introduction, very rarely occur as inde-
pendent affections.   They are usually combined with analogous
diseases of either the larynx or the bronchi.   We shall not,
therefore, present a detailed description of independent catarrhal
inflammations of the trachea, but shall keep in view chiefly that
form in which it comes most frequently under observation, that
is, the so-called *tracheo-bronchitis*, in which it is associated
with a simultaneous analogous affection of the larger bronchi.
On the other hand, that form of tracheitis which is associated
with an analogous affection of the larynx must be referred to
the corresponding chapter on diseases of the larynx.   In the
same manner the croupous processes of the trachea, which
almost always take their starting-point from an analogous affec-
tion of the larynx, will, to avoid repetition, be referred to the
appropriate chapter of the article on diseases of the larynx.

Acute catarrh of the trachea, which, as above stated, almost always occurs in combination with an analogous disease of the larger bronchi, may occur either as an *independent disease* or as a *symptomatic* or *secondary affection*, as in the acute exanthemata, typhoid fever, and other diseases. Inasmuch as the symptoms of these different forms are identical, it may suffice here to describe those of the one which most frequently occurs, viz., primary acute tracheo-bronchitis, in its principal features.

Acute catarrh of the trachea and the larger bronchi is a form of disease which is observed at every age of life, but which exhibits different shades according to the severity and extent of the catarrhal inflammation, the age and individuality of the patient, and other circumstances. Very often, though by no means as a rule, as asserted by some, acute tracheo-bronchitis begins *with a catarrh of the pharynx or of the nasal mucous membrane, or of the larynx also.* In these latter instances either the symptoms of the coryza, the pharyngeal catarrh, and the like, precede the symptoms of the tracheo-bronchitis by a brief period, or both become developed at the same time.

In not infrequent instances, sometimes from greater intensity of the affection or in irritable constitutions, the commencement is ushered in, as in pneumonia, *by slight chills, but rarely with a marked rigor.* It is of significance, however, as also stated by Niemeyer, that there is seldom a single paroxysm of chill. The patient complains rather of frequently recurring slight sensations of chilliness, which are followed by sensations of heat, without giving rise to any thermometrical evidences of a temperature much above the normal standard. There is often, in addition, pain in the forehead, a feeling of languor and weakness in the limbs; usually, also, diminution or even loss of appetite, increased thirst, and the like; in short, a group of symptoms formerly often inappropriately designated as "catarrhal rheumatic fever," especially when they immediately followed taking cold.

In most instances this fever attends tracheo-bronchitis but for a short time, and the temperature seldom rises above that which characterizes a slight fever, except in children, in whom also the acceleration of pulse does not always preserve that rela-

tion to the increase of temperature, which is observed in the case
of adults, but often exceeds it to a considerable degree.

The fever is usually *remittent*, without otherwise exhibiting
any special peculiarities ; it is very rarely intermittent in char-
acter.   The great disposition of this catarrhal fever, as it is often
improperly termed, to the development of sweating, is worthy of
remark.

Cough is always present, and may even appear at the com-
mencement of the disease.   As previously remarked,[1] it has been
experimentally proven that irritation of the tracheal and bron-
chial mucous membrane excites cough, and that of all points of
the trachea and bronchi *cough is most readily excited at the
point of bifurcation*.   This coincides with the fact that catarrh
of the mucous membrane of the trachea and upper section of the
larger bronchi is usually associated with very severe cough,
while catarrh of the deeper sections of the bronchi, and of the
medium-sized and smaller bronchi, often occasions but slight
cough.

For the first few days the cough is dry, a simple cough of
irritation, which may or may not be attended by insignificant
expectoration, according to the severity of the hyperæmia
and swelling of the mucous membrane existing at this stage.
The cough is not muffled and hoarse except when there is a
complication with an analogous affection of the larynx.   On the
contrary, as long as there is no extensive secretion from the
mucous membrane, it has often a cavernous, barking sound,
and is sometimes characterized by actual spasmodic paroxysms
(*spasmodic cough*).   Furthermore, the cough frequently increases
in intensity during the horizontal decubitus, to become less fre-
quent and less severe upon the resumption of the upright posi-
tion.   This is explained by the fact that in this position not only
is it easier for the patient to breathe deeply, but the mucus is
less likely to be detained at the points of irritation ; it is also
explained in a measure by the excessive sensitiveness of the
mucous membrane of the posterior wall, and especially of the

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[1] See " Introductory Remarks," also *Nothnagel*, Zur Lehre vom Husten, Virchow's
Archiv, Bd. XLIV., and *Kohts*, Experimentelle Untersuchungen über den Husten, Vir-
chow's Archiv, Bd. LX., Hft. 2.

inter-arytenoidal incisure, a locality in which the mucus easily becomes accumulated during rest in the horizontal position. The severest grade of spasmodic cough is therefore also observed in those forms of tracheitis which are combined with a laryngitis, the so-called *laryngo-tracheitis.*

The patient frequently complains of a feeling of pressure, constriction, and fulness of the chest. On the other hand, characteristic stitches in the side, the occurrence of which in tracheo-bronchitis is mentioned by some authors, do not belong to the disease as such, but rather suggest the suspicion of some complication. Painfulness of the muscles of expiration is not infrequently observed, especially in those forms associated with severe spasmodic cough.

Traube[1] further distinguishes, as a diagnostic indication of tracheal catarrh, an abnormal sensitiveness of the trachea to pressure, and the ready excitement to cough produced by this pressure.

After a short time, in most instances after but a few days, the cough loses its dry character and becomes looser, for the mucous membrane now furnishes more secretion, which is more readily detached. Considerable subjective amelioration goes hand in hand with this loosening of the cough and increased production of mucus. If fever had been present previously, it then subsides completely in this stage in most instances, and the patient in mild cases then gradually progresses towards convalescence.

It is otherwise in severe forms, whether they have appeared as such at the commencement, or have become so later. Here the affection not only lasts a considerably longer time, but the individual manifestations, such as the fever, the general languor, the cough, and similar symptoms, take on a more intense character. In nurslings and young children, especially, the dyspnœa often reaches a considerable degree. Indeed, certain observers, as Rilliet and Barthez, describe such cases in children which progressed to a fatal termination under symptoms of eclampsia and asphyxia, without any further complication.

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[1] Die Symptome der Krankheiten des Respirations u. Circulationsapparates, Bd. I., 1867.

The *expectoration*, but scanty at first, is always a transparent, foamy mucus at the commencement. It gradually becomes more abundant, contains more and more of yellow stripes between the transparent masses of mucus, and then always becomes richer in cells and less translucent. Finally, becoming constantly richer in cells, it reaches that consistence which we have described in a previous article as belonging to the *sputum coctum*. In general, too, as the expectoration gradually becomes richer in cells, the cough is also looser and less straining, and the breathing is facilitated to a corresponding degree.

As far as *physical examination* is concerned, it is self-evident that the *percussion sound* never undergoes any essential modification, even in intense forms of tracheo-bronchitis. It is otherwise with *auscultation*. If the mucous membrane of the trachea and the larger bronchi is swollen to a considerable degree, or if viscid, tenacious masses of mucus are adherent, then auscultation along the course of the trachea and larger bronchi reveals *dry râles, the so-called sonorous râles (rhoncus sonorus, râle sonore sec* of Laënnec). These râles are produced by the friction of the current of air upon the much swollen tracheal and bronchial mucous membrane, which at this stage furnishes but very little fluid product or none at all. If smaller bronchi are also the seat of this swelling, then we speak of *whistling and sibilant râles (rhoncus sibilans)*. In addition, the term sibilant râle is also applied to those shrill tones which occur when viscid mucus almost closes a bronchus, so that but a narrow slit remains.

Only very seldom does a simultaneous swelling of the submucous tissue occur to such a degree as to constrict the calibre of the tubes. This takes place somewhat more frequently in chronic inflammation, which may even give rise to induration of the submucous tissue, to simultaneous hypertrophy of the cartilages, with or without calcification, and to other conditions of similar character.

Concerning the symptoms that are manifested under these circumstances, the reader is referred to the chapter on tracheal and bronchial stenosis.

These sonorous râles in the trachea and bronchi are distin-

guished from all other râles by their marked *intensity*. They are much louder than the moist râles, and are frequently audible not only at those places in which they arise, but even over a wide extent of the thorax. They are frequently so loud and intense as to attract the attention of the patient and those about him. Under certain circumstances they can even be felt with the hand. In cases of slight severity they are audible only at the points at which they arise, and are therefore to be sought for along the trachea and in the region of the root of the lung.

In many cases these rhonchi have an intensity so considerable that they mask all the other thoracic sounds, so that even the characteristic *respiratory murmur* can no longer be detected. Where, on the other hand, the respiratory murmur can still be heard, slight changes in it are sometimes found; it is at times somewhat weakened, and then at others sharpened. In other cases it remains normal.

At a later stage, when the secretion is less viscid, and has become richer in cells, the character of the rhonchi becomes altered. *Moist râles* take the place of the sonorous râles,—râles which may be designated as *coarse*, inasmuch as they occur only in the trachea and the larger bronchi. The designation of these râles as moist in no wise confirms the usual theory that they are produced by the passage of air through the secretion contained in the bronchi, and the bursting of the air-bubbles formed in this manner. We shall have an opportunity later to return to this theory, and to the objections brought against it by Traube [1] especially.

In proportion as the secretion of the tracheal and bronchial mucous membrane again becomes less, the râles become sparser, until they are finally entirely replaced by the normal sounds. In most instances all the manifestations mentioned give place to the normal state of things after a short time, corresponding to the brevity of the duration of the general affection.

Concerning *palpation* it is only to be mentioned that under certain circumstances the fremitus of the rhonchi may be felt by

[1] *Hertel*, A case of chronic bronchial catarrh and enlargement of the volume of the lungs, with remarks on cyanosis, bronchial catarrh, bronchiectasis, and the phenomenon of the diastolic double-tone. Berlin. klin. Wochenschr., 1871, Nos. 26, 27.

the hand ; these rhonchi being conveyed to the thoracic walls, where they are felt as vibrations.

Inspection furnishes no characteristic results in catarrhal tracheitis and bronchitis.   In ordinary cases the disease, especially in adults, gives rise to no disturbance in the respiratory movements, either in form or in frequency.

The *expansibility of the thorax* is but insignificantly diminished, or not at all affected.   In severe grades, however, there exists, in addition to *subjective dyspnœa*, a disturbance of breathing in this respect that *the respiration is accelerated*, without undergoing, in most instances, any considerable diminution in depth ; on the contrary, the individual breaths sometimes exceed the average of normal expansion which they exhibited in conditions of quiet, uniform breathing.   This manifestation is in complete harmony with the experimental results of the influence of progressive constriction of the trachea.   On the other hand, the impediment to the aerial current in the trachea hardly reaches such a grade as to occasion that form of respiratory type which we shall have occasion to mention later, in connection with tracheal stenosis, as belonging to the severer grades of this affection, and which also occurs in the higher grades of laryngeal stenosis.   It only happens very exceptionally that an acute swelling of the mucous membrane and submucous tissue leads to a high degree of this sort of stenosis.   Such a stenosis occurs much more frequently through chronic swelling of the mucous membrane and submucous tissue, through œdema, through perichondritis, through hypertrophy and induration of the tissues named, with the formation of callosities and cicatrices, especially as a sequence of syphilis.[1]

In children, as a matter of course, dyspnœa occurs, in severe grades of swelling of the mucous membrane, much more readily than in adults.   Further, according as the affection is associated or not with *fever*, there is or is not a further basis afforded for dyspnœa.   Moreover, a certain dependence of dyspnœa upon the paroxysms of cough may be recognized, inasmuch as the severity and frequent recurrence of the paroxysms of cough seem to increase the dyspnœa.

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[1] Consult the chapter on tracheal stenosis.

The remark of Traube [1] is furthermore worthy of mention, viz., that the symptomatic picture belonging to catarrh of the minuter bronchi may be produced by the downward flow of a copious tracheal secretion into the bronchial tract.

The *appearance* of the patient is not materially altered in most instances. In cases in which tracheo-bronchitis appears at the same time with coryza, or is preceded by it, the face is frequently reddened, the nose is swollen, the eyes are watery, and the lids are often somewhat puffy. Tracheo-bronchitis, as such, on the contrary, hardly ever occasions any material alteration in the appearance of the patient. Only slight grades of cyanosis are observed here, as a rule, and even these are frequently enough altogether wanting.

Among further symptoms and complications still to be mentioned are mild *gastric* manifestations which sometimes attend the bronchitis. Even in the first few days the *appetite* appears to be impaired, and the tongue coated; sometimes, especially with severe and exhausting paroxysms of coughing, even *vomiting* is observed; sometimes, too, there is a disposition to constipation, and less frequently, a disposition to diarrhœa. Sometimes these mild gastric disturbances continue for quite a long time, in some cases even to the period at which the manifestations on the part of the respiratory apparatus have already begun to retrograde.

Sleep is disturbed, especially at first, by the severe paroxysms of coughing which during this period result from the dry and swollen condition of the mucous membrane. With the loosening of the secretion from the mucous membrane, and the consequent diminution of the irritation to cough, sleep improves, as a rule. Other nervous symptoms are usually absent, except that in very small children severe cerebral symptoms sometimes become developed, these partaking at one time of the character of excitement, at another of the character of depression. Even slight convulsive twitchings of the face, or of the limbs also, and temporary rigidity of the trunk and limbs have been mentioned by some observers.

[1] Die Symptome der Krankheiten d. Respirations- u. Circulationsapparates, Bd. I., 1867.

The most frequent termination, as already mentioned, is in recovery. A fatal termination occurs only exceptionally in acute tracheo-bronchitis, in patients already considerably debilitated by previous diseases.

In other cases, on the other hand, recovery does not take place after a short time, but the catarrh gradually spreads along the finer divisions of the bronchi, and continues for months, or even years, sometimes with slight, and sometimes with severe exacerbations and remissions. In many cases acute tracheo-bronchitis thus passes into the chronic form, or into a diffuse bronchitis.

II. *Acute Catarrh of the Medium-sized and Minuter Bronchi, Bronchitis Capillaris, Acute Diffuse Bronchial Catarrh.*

Inasmuch as we contrast acute catarrh of the trachea and larger bronchi with that of the medium-sized, and smaller bronchi, and with bronchiolitis, we must commence with the remark that such a sharp distinction as we shall have to present in the description of the individual varieties does not by any means always exist in practice. On the contrary, daily experience sufficiently shows that numerous transitional and intermediate forms exist. Thus we not infrequently see both forms more or less combined in such a manner that, in addition to a catarrh of the trachea and larger bronchi, a few medium-sized and minuter bronchi are affected also. In one series of cases the bronchiolitis and broncho-pneumonia begin in the finer bronchial branches from the very commencement. In other cases, on the other hand, the disease begins with a catarrhal inflammation of the larger bronchi, and thence extends into the smaller bronchi.

Acute diffuse bronchial catarrh represents that form of bronchitis in which most of the bronchial tubes are affected, tubes therefore of very different calibres. Hence, capillary bronchitis is, to a certain degree, also included in diffuse bronchial catarrh, inasmuch as at least some of the minuter bronchi are affected as a rule. The course of the affection is frequently such that the larger and medium-sized bronchi are affected in the first instance, and then the process is extended secondarily upon the

smaller and minutest bronchial ramifications. Thus cases are frequently encountered in which bronchial tubes of the most varying calibre—larger, medium-sized, and minute alike—are all simultaneously involved in the affection. As is self-evident, the danger and significance of the affection are increased with this extension of the catarrhal-inflammatory process upon smaller and smaller, and finally upon the minutest bronchi. Should these be naturally very narrow it may readily happen that the passage of air through them may be impeded to a great degree, and at times totally prevented, in cases of severe inflammation and swelling, and of copious accumulation of secretion. In this way considerable disturbance may be occasioned, and the affection may readily involve great danger, especially in children, in whom the calibre of the bronchi is so small.

Capillary bronchitis is by no means always a secondary development from a bronchitis of the larger tubes. Independent forms are not infrequently observed, especially in childhood and in advanced age ; while in middle life the disease is for the most part a secondary process arising in the manner mentioned, or a secondary affection or consecutive disease associated with other diseases, especially infective maladies, such as diphtheritis, the acute exanthemata, erysipelas, typhoid fever, and the like.

As a further characteristic of capillary bronchitis, the circumstance must be mentioned that lobular catarrhal pneumonia is not infrequently developed in immediate connection with it ; the pneumonia always representing a *secondary condition*. Catarrhal pneumonia affects the lower lobes of the lung most readily, and especially those portions situated near their posterior borders. The inflammatory process here extends from the minuter and terminal bronchi upon the lung texture itself, which now appears dark red in color, and swollen, at different points. The catarrhal inflammatory process then gradually extends forwards and upwards from the posterior and inferior sections of the lungs affected in the first instance.

As, however, there is no mucous membrane in the lung, the process which appears as a catarrh in the mucous membrane of the medium-sized and smaller

bronchi, must, as Buhl[1] observes, be considered as transferred to the pulmonary parenchyma in a highly modified manner. If, as Buhl says, an affected lung be closely examined, it will be found to display an inequality of texture. In one part there are places where the tissues are gorged with blood, swollen and prominent; ecchymoses are also noticeable upon the pleural surface, and from the cut surface of the lung not only more blood escapes, but also a serum copiously mingled with air-bubbles (*acute œdema of the lungs*). In another part, and especially at the edges of the lungs and towards their roots, the alveoli are seen collapsed, retracted, nearly or entirely empty of air, and colored blue red (atelectasis). In other lobules again, on the contrary, the pulmonary vesicles are found very much distended with air, pale, and richer in blood only at their circumference, as if enclosed by a wreath of injected vessels (local emphysema). Finally, lobules are found which when cut with the knife show a smooth, somewhat hard non-granular cut surface, that projects above the level of the rest of the section, and displays disseminated yellow spots of the color of pus. Lobules like these are generally found in cases of bronchitis of long standing.

This appearance is due to the alveoli being filled, not with fibrinous, but with thick mucous secretion rich in pus corpuscles. The immediate vicinity of these foci is also distinguished by the presence of an increased proportion of blood. In addition to the accumulation of mucus and pus corpuscles, the microscope also detects epithelium in a state of fatty degeneration, though in insignificant quantities. The same condition is also found diffusely distributed in the œdematous localities, the inflamed portions sending processes into the surrounding tissues (Buhl).

Of all these alterations only the filling of the lobules with mucus and pus can be considered, as Buhl states, as belonging to the catarrhal process. Buhl considers that the greater part, if not all, of the catarrhal product lying in the alveoli originates from the bronchi and is sucked in by aspiration, and is no longer removable on account of the simultaneous obstruction of the bronchial twigs with which they are connected; this being especially proved by the co-existence of simple œdematous lobules, with atelectatic and emphysematous ones. "Although the purulent accumulation in the lobules of the alveolar parenchyma is apparently not a direct inflammatory product, it must not be asserted that the lung tissue cannot eventually become subjected to inflammatory irritation in consequence of the long continuance of this condition" (Buhl).[2]

Returning again, after this digression concerning the anatomical relations of catarrhal pneumonia, to diffuse and to capillary

[1] *Buhl*, Lungenentzündung, Tuberculose u. Schwindsucht. München, Oldenbourg, 2. Aufl., 1873.

[2] Concerning the minuter anatomical details of catarrhal pneumonia, we refer the reader especially to *Friedländer's* admirable work, the conclusions in which differ from those of *Buhl* in many points. We also refer to *Jürgensen's* chapter on Catarrhal Pneumonia, in Vol. V. of this work.

bronchitis, we must first direct attention to the much greater severity of this affection in contrast to that of tracheo-bronchitis. With the greater extension of the catarrhal inflammatory process from the larger to the smaller bronchi in many different parts of the lung, the respiratory interchange of gases must be disturbed to a great degree, and the circulation too, therefore, secondarily. The more the access of air to the alveoli is impeded by the swelling and occlusion of numerous, especially the minuter bronchial tubes, the less sufficient is the decarbonization of the blood, and the more readily symptoms of asphyxia may occur, as is frequently enough seen, particularly in the capillary bronchitis of children. That suffocative symptoms occur more readily in children than in adults may be readily explained by the difference in the anatomical conditions, —viz., by the smaller diameter of the minuter bronchial tubes in children, for the occlusion of which moderate swelling and accumulation of mucus are amply sufficient.

In turning, now, to the description of the individual symptoms and the course of the disease, we will consider them separately, as they occur at different periods of life and under different circumstances, inasmuch as the clinical picture varies in many particulars according as the disease affects young children, adults, or old people, and in consequence of other conditions also.

The limits of a manual like this do not afford sufficient space to present a separate description of all these individual forms. Concerning this point the reader is especially referred to the recent monograph of Lebert,[1] and also to the numerous special monographs, upon the very interesting subject of the capillary bronchitis of children. We will present the picture of the disease in its principal outlines, and devote special attention only to the more important differences of the individual varieties.

Diffuse bronchial catarrh, as well as *capillary bronchitis*, may either commence as such from the very beginning, or may become developed from a simple tracheo-bronchitis. Whether it has made its appearance in one way or the other, the *breathing* in these cases is always more or less disturbed. In both

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[1] Klinik der Brustkrankheiten, Zwei Bände. Tübingen, Laupp, 1873, 1874.

diffuse and capillary bronchitis the breathing is usually accel-
erated and more labored, and the dyspnœa is always closely
proportionate to the amount of impediment in the air-pas-
sages. In mild cases the dyspnœa is restricted to a moderate
degree, but under certain conditions it may increase to a very
severe degree, and even to almost suffocative want of breath.
Severe dyspnœa is often developed with especial rapidity in the
capillary bronchitis of children. The smaller the original calibre
of the bronchial tubes, the more readily will a moderate swelling
and accumulation of mucus occasion complete impermeability.
This explains why the breathing is often considerably impeded
and accelerated in nurslings and small children;—and it is just
during the first three years of life that they are most frequently
attacked by capillary bronchitis and catarrhal pneumonia. As
a rule, the individual breaths are short and interrupted; at
intervals, even suffocating paroxysms set in, in which the dysp-
nœa increases to a very severe degree; the children are often able
to breathe only in the semi-recumbent posture; they obtain no
rest; they change their position continually; the nostrils dilate
powerfully with each inspiration; the countenance is cyanotic;
the thorax is drawn up in a hasty manner, and by jerks; the
lowest portion of the sternum and the lower ribs undergo
even an inspiratory retraction, especially upon deep inspira-
tion.

There are also numerous cases in children in which the dysp-
nœa, as well as all the other manifestations, exhibits a less active
character. This is not only the case in the milder grades of
bronchiolitis, but in severe cases also, when they concern little
children already much weakened by previous diseases, in which
instances catarrhal pneumonia soon becomes readily added to
the existing condition. The children lie in bed apathetic, awa-
kened from their semi-slumber at intervals only by severe
paroxysms of cough; the lips and face are strongly cyanotic;
the pulse is small, and often it is impossible to count it.
These cases represent the variety described by Rilliet and
Barthez under the name "Cachectic Broncho-pneumonia of
Children."

In *elderly subjects* a more insidious course is not infre-

quently observed. Dyspnœa is indeed present, and the breath-
ing is shallow and accelerated, but the number of respirations
hardly reaches that observed in children; in short the entire
symptomatic manifestations progress in a far less stormy man-
ner in most instances.

In *adults*, also, the diseases under consideration for the most
part produce a moderate grade of dyspnœa,—never so intense
as that which is observed in children. We do not observe here
that stormy, galloping, though nevertheless superficial breath-
ing which we have the opportunity of observing—and by no
means infrequently—in children. The number of the respira-
tions is sometimes increased to a third above the normal stand-
ard in adults, and even to double the number and more; but
nevertheless the frequency of the respiratory efforts is far
removed from that which we are accustomed to see in children.

The *type of breathing*, much as it differs from the normal,
exhibits no deviation in any way characteristic of the affection
under consideration. In the more diffuse form of bronchitis,
the only noticeable change frequently consists in nothing more
than slighter and less extensive movements of the thoracic
walls; the relations of the individual phases of respiration to
each other being hardly appreciably disturbed. In the capillary
bronchitis of children, which occurs particularly in nurslings,
and in the very earliest years of life, a more abrupt, jerky
breathing is frequently observed; so that despite powerful con-
traction of all the inspiratory muscles an intermission occurs
again and again. Both inspiration and expiration appear im-
peded, and the auxiliary expiratory forces are called into play.
Thus both acts of respiration are impeded, while the relations
of the two phases to each other remain nearly the same as in
normal breathing. Biermer,[1] describes, also, the occurrence of
a type of respiration similar to that observed in asthma. We
will recur later to its more detailed peculiarities in our descrip-
tion of asthma.

A temporary intermission of the dyspnœa is not infrequently
observed, and generally the degree of dyspnœa is frequently

[1] Bronchienkrankheiten, in Virchow's Handbuch der speciellen Pathologie und
Therapie.

changeable in that form of bronchitis under consideration. A frequent cause of rapid increase of dyspnœa is to be found in plugs of mucus which suddenly obstruct a larger or smaller bronchus, and then become detached at a later period.

Although the dyspnœa exhibits now a severer, and now a slighter degree, according to the extent over which the process is distributed, and the age of the affected individual, it almost always reaches its maximum gradually within a few days or after a longer period, maintains its height, with remissions, for some time, and then gradually decreases. In children deception may readily occur in consequence of this relatively slow progression of the dyspnœa and other manifestations, so that the attendants often mistake the affection at first for a trifling one, until by the rapid increase of the dyspnœa to its maximum within a short period, especially upon the onset of a catarrhal pneumonia, or, more frequently, by the rapid emaciation, by severe febrile exacerbations, and the like, they are taught that it is something more severe.

Percussion reveals no deviation from the normal condition as long as no further complications are present ; these, however, are by no means infrequent. Where, however, as is especially frequent in the capillary bronchitis of children, alveolar thickenings, atelectasis, and the like are superadded, an alteration in the percussion sound is frequently observed ; but by no means always. It may be lacking even in catarrhal pneumonia, when the pneumonic foci are very small and are entirely enclosed in parenchyma containing air.

In other cases the full, clear, pulmonary resonance exceeds the normal limits, as in emphysema, especially when an acute dilatation of the lung is added to the existing conditions.

Where the lung power is insufficient, in capillary bronchitis, to overcome the obstruction, atelectasis must occur in places. Concerning the other results ascertained by percussion, we have to do only with the occasional occurrence of an extension of cardiac dulness, produced by dilatation of the right side of the heart in diffuse and widely extended bronchitis. This is readily explained by the disturbed condition of the circulation.

Auscultation furnishes numerous deviations from the normal

condition. The respiratory murmur is sometimes normal, but it is more frequently enfeebled. Less frequently it is rough and harsher than normal, or it may even be muffled and indistinct. The expiratory murmur, particularly, is often harsher than normal.

Of greater significance are the numerous râles which at times are to be heard distributed over nearly the entire thorax, as in diffuse bronchitis, and at other times are discernible only over small, circumscribed sections of the thorax. Sometimes the râles are loud and moist; sometimes they are more dry; sometimes we hear only small bubbling râles, and then again an admixture of sonorous, whistling, large, and small bubbling râles. According to whether the process is spread over nearly all the bronchial ramifications, or over only a few, especially the smaller ramifications, and according to the quantity and viscidity of the secretion, the sounds produced must be of varying characters. An interchange of these râles within short periods of time is demonstrable frequently enough.

Concerning the diagnostic significance of the different râles, it may be permitted to add a few remarks. As is well known, the existence of moderate-sized, bubbling, muffled râles formerly led at once to the conclusion that fluids were present in the middle-sized bronchi. That this conclusion is inaccurate has been shown by Traube [1] especially. Concerning the crepitant râle of Laënnec, it was long ago shown that it also occurs in cases in which, beyond a doubt, no fluid is present in the air-passages. As regards the moderate-sized, bubbling, muffled râles, Traube first furnished the evidence of their occurrence even in cases in which there was no fluid in the bronchi. Thus, he observed them in cases of commencing pleuritis, and in moderate hydrothorax. From these and other facts Traube justly draws the conclusion that the existence of a fluid in the air-passages is by no means a necessary condition for the occurrence of such râles. The similarity between those râles which are produced by liquid in the air-passages, and those which certainly occur without the help of a liquid, justifies the assumption of a common cause. Traube, therefore, considers as inaccurate Laënnec's view that the râles produced by fluid in the air-passages are due to the passage of the air in larger or smaller bubbles through the fluid; he attributes them rather to the successive detachment of the viscid bronchial contents, as a whole, from the bronchial wall in the acts of inspiration and expiration. The inspiratory râle is due to the entrance of the air with a certain quickness into the little empty spaces left by the detachment of the bronchial

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[1] Berlin. klin. Wochenschrift, 1871, Nos. 26, 27.

contents. The occurrence of the expiratory râles is to be accounted for in the same manner, according to Traube, only that here the condensation of the air in the pulmonary parenchyma, and not its rarefaction, acts as the propulsive power for the penetration of the air between the bronchial wall and the bronchial contents. The râles, then, which occur without fluid in the air-passages are essentially due to the same mechanism.

This is not the place, however, to enter into the consideration of the mechanism and interpretation of the various râles.

Cough occurs with variable frequency. It is often severe, and even spasmodic. Expectoration is often altogether wanting for a long time, or only isolated viscid sputa are expelled after long-continued, severe paroxysms of cough, attended with great straining. In contrast to the form of tracheo-bronchitis already described, in which in most instances the cough loosens after a short time, in this form, difficult expulsion of the secretion often continues for a long time.

Among the remaining symptoms, the *febrile manifestations* are the first to be discussed. Slight febrile movements almost always accompany both diffuse acute bronchitis and capillary bronchitis. The fever, however, very seldom reaches a high degree of severity. High temperatures, that is, up to 40° C. (104° F.) and above it, are only exceptionally observed. Those chronic catarrhs also, which suddenly acquire an acute character from the influence of some new irritant, and which up to that time had progressed without fever, then, as a rule, become associated with mild febrile movements. In favorable cases the fever soon subsides again with the abatement of the severe paroxysms of cough, and the occurrence of easier and more copious expectoration. It is just these forms that evince a special disposition to recurrences and acute exacerbations. In old people, as a rule, but slight elevations of temperature are observed.

The capillary bronchitis of children is usually associated with but moderate febrile movement, the temperature being ordinarily maintained at 39° C. (102.2° F.). It is in these very cases that observations of temperature, as first mentioned by Ziemssen,[1] are of great diagnostic significance, inasmuch as the transition of bronchiolitis into broncho-pneumonia is often so latent

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[1] Pleuritis und Pneumonie im Kindesalter. Berlin, 1862.

that it may evade observation. If careful examinations with the thermometer are made it will be found that the temperature increases rapidly with the onset of the broncho-pneumonia, and often reaches 40° C. (104° F.), and even higher figures, although it had previously remained at or below 39° C. (102.2° F.) (Ziemssen). This is not to be construed to mean that every elevation of temperature above 40° C. (104° F.) is an indication that the disease can no longer be a capillary bronchitis, but must already have become a catarrhal pneumonia. I have repeatedly observed a temperature of 40° C. (104° F.) and over in the simple capillary bonchitis of children in whom the affection has been verified on autopsy. That higher temperatures may also exceptionally be observed in capillary bronchitis is by no means to be denied. As Ziemssen justly remarks, the onset of a catarrhal pneumonia in a case of capillary bronchitis is usually indicated by a sudden exacerbation of temperature. Inasmuch as the elevation of temperature is only moderate, as a rule, in capillary bronchitis, a sudden rise from this moderate level to a point above 40° C. (104° F.) suggests the probability of the onset of a catarrhal pneumonia.

The action of the heart and *the pulse* exhibit, in general, an acceleration corresponding to the height of the fever. In children, on the other hand, the acceleration of pulse does not correspond with the elevation of temperature, being much greater, as a rule. It reaches even 140 and more in the minute, and sometimes the pulse is so rapid that it can hardly be counted. In adults the frequency of pulse rarely, or but little, exceeds 100 in the minute. At the commencement of the affection the pulse is usually full and tense; at a later period it is small.

The *skin* is usually dry at the commencement; at a later period, on the other hand, there is frequently a disposition to sweating. Marked *cyanosis* often becomes developed in a short time in the severe forms of the bronchitis under consideration, especially in the form of catarrh associated with symptoms of asphyxia, a form in which the numerous bronchi become filled with very copious, tenacious mucus, so that the penetration of air into them is impeded to a very great degree.

The more considerable the swelling of the mucous membrane,

the more extensive the occlusion of the bronchi, and the more sudden its occurrence, the more readily will severe cyanosis be likely to ensue.

The *appearance* of the patient often undergoes considerable alteration in a short space of time, in cases in which many, and especially the minuter bronchi, are obstructed. Apart from the cyanosis already mentioned, which exists in marked degree in the lips, ears, nose, nails, and the like, the features of the patient exhibit a certain inquietude and anxiety corresponding to the disturbance of respiration. With longer duration of the respiratory disturbance a certain degree of apathy and somnolence often sets in ; the extremities become cool and markedly cyanotic, and, with increasing sopor and constantly increasing cyanosis, the patient in severe cases dies suffocated.

The condition of the *urine* exhibits nothing characteristic. It is usually small in quantity, concentrated, and rich in urates, and sometimes a small quantity of albumen is observed in the later stages.

Cerebral symptoms are always wanting in the milder cases. In severe cases, especially when a catarrhal pneumonia has become superadded to the capillary bronchitis, cerebral symptoms are frequently observed towards the end, sometimes even recalling the picture of tuberculous meningitis.

In acute diffuse bronchitis, on the other hand, hardly any severe cerebral symptoms are observed.

Gastric disturbances of slight grade are likewise not infrequently observed. In children, especially, vomiting often occurs, and even diarrhœa. Loss of appetite is usually observed, for a longer or shorter time, in the majority of these forms.

As regards the *subjective symptoms*, there is frequently more or less severe feeling of oppression, considerable shortness of breath, and lassitude. On the other hand, with the exception of that produced by the efforts to cough, the disease, as a rule, is not accompanied by any severe pain.

The *expectoration*, as in catarrh of the trachea and coarser bronchi, is also scanty at the commencement, and expectorated with difficulty. After a short time it usually becomes more copious, and at the same time less tenacious. The sputum is

at first more mucous, later it becomes richer in cells and more
consistent, and, in addition, sometimes exhibits the following
special characteristics : Inasmuch as the secretion which fills the
minutest bronchi is not mixed with air, it tends to sink in water,
its specific gravity being greater than that of water ; and when it
possesses a certain tenacity and coherence it retains the form of
the minutest bronchi, and at the same time adheres firmly to the
secretion coming from the larger bronchi, which is mixed with
air, and which therefore floats upon the water.   Thus the expec-
toration forms a foamy layer upon the surface of the water,
from which thin threads hang down below the surface (Seitz,
Niemeyer).   Frequently enough the expectoration of these sputa
is tolerably difficult.

The *course* of the forms described varies in different cases.
In general, however, certain methods of progress may be re-
garded as the rule ; and these we will detail briefly in describing
the individual symptoms.

Let us first consider the *acute diffuse form of bronchitis*,
which is by no means to be reckoned as an infrequent affection
among adults.   In general it does not often happen that the
acute diffuse bronchitis begins without other prodromes.   Some-
times the symptoms of a mild acute tracheo-bronchitis, an
angina, a coryza, or the like, precede the affection for some
time, and then the symptoms of an acute diffuse bronchitis
become developed ; in other cases both sets of symptoms make
their appearance simultaneously.   It frequently happens, also,
in individuals who have already suffered for some time with
chronic bronchial catarrh, that the catarrh suddenly takes on an
acute character in consequence of some new injurious influence.
These severer symptoms of acute diffuse bronchitis sometimes
become developed with great rapidity from a simple, mild,
chronic, bronchial catarrh.   In other cases the acute diffuse
bronchitis becomes developed suddenly under the influence of
some accidental cause, as taking cold, or becoming thoroughly
wet.   In other cases, again, the bronchitis is superadded to other
existing affections, such as the acute exanthemata, cardiac insuf-
ficiency, Bright's disease, and the like.

It occurs in a similar manner, both in adults and in chil-

dren, only that, as a matter of course, in children it gives rise to severe symptoms much more readily.

This form is frequently observed in aged persons also, but it is more apt to progress under adynamic manifestations.

The commencement of acute diffuse bronchitis is usually sudden, with a light febrile movement, which is frequently preceded by a slight chill, or by repeated chilly sensations. A certain amount of dyspnœa is rapidly superadded, with short, and at first dry cough, which occurs in frequently recurring severe paroxysms ; the respiration is accelerated, short, superficial, and frequently accomplished only with the aid of the inspiratory and expiratory muscles.

In those cases, also, in which diffuse bronchitis does not commence suddenly but is rather preceded, for a longer or shorter period, by slight bronchitic or other manifestations, the severe symptoms usually become rapidly developed to their maximum within one or more days. In those instances in which the individual attacked has been debilitated by a previous ailment, or is still suffering from some disease, the bronchitis may, within a short period, develop even suffocative symptoms.

The temperature soon increases above the normal standard, but stops at 39° C. (102.2° F.), or even a lower point in the majority of cases. This temperature is only exceptionally exceeded, and then chiefly when further complications, especially on the part of the alveolar parenchyma, become superadded. The action of the heart, also, is moderately accelerated in the majority of cases ; but often the acceleration of pulse does not remain directly proportionate to the increase of temperature, but is then much more considerable than would be anticipated from the moderate increase of temperature. The pulse often shows a remarkably increased tension, at least in severe cases. In the form of disease under consideration, it may be taken for granted that this increased tension, which, as Traube long ago remarked, occurs in various affections of the respiratory apparatus with the onset of dyspnœa and cyanosis, has its cause only in the repeated and prolonged contraction, into which numerous small branches of the aortic system are thrown by the influence of the accumulated carbonic acid gas. At all events, in certain very

severe forms this explanation is amply sufficient, and probably the correct one.

The sudden extensive diminution of the calibre of numerous air-tubes produces considerable oppression and anxiety. The patient is often unable to gratify his desire for air, despite the assistance of the auxiliary muscles of inspiration; he changes his position frequently, and even assumes the sitting posture, because he can in this manner most readily satisfy his desire for air. In spite of all this the dyspnœa continues, even though only moderate in degree in most instances; at times, however, it may become considerably increased by severe paroxysms of cough. Despite these severe paroxysms, the expectoration is but slight at first; in some instances there is no expectoration at all, especially during the first days. It is only after some time that the expectoration becomes more copious, and then it shows the characters already described. Auscultation at this time reveals the most various râles, extending over the entire thorax; the respiratory murmur now failing altogether at certain points, and again being audible after the expulsion of sputa has freed some of the bronchi, while at still other points it is again indistinct or feeble. At the same time the fever remains at about the same height, with but slight morning remissions and evening exacerbations.

This condition is maintained for a variable period, usually for a series of days, at the same height, and then gradually improves. The expectoration then becomes more copious, and is more readily detached; it loosens, so to speak, it becomes richer in cells and more puriform; the fever diminishes; the cyanotic manifestations usually subside, as more numerous bronchial twigs become pervious again; the severe paroxysms of cough become less and less frequent; the breathing becomes steadily easier; the appetite, which up to this time has usually remained in abeyance, returns again; and in this manner the patient gradually passes into convalescence.

In other cases, especially in aged subjects, and in persons already laboring under chronic catarrh or emphysema, or already weakened by some former disease or by one that still continues, all the symptoms mentioned undergo progressive

increase. Evidences of adynamia soon become apparent, the cyanosis gradually becomes more severe, and the expectoration becomes more and more difficult; and often even the sensorium becomes implicated, delirium and comatose symptoms manifesting themselves; the cyanosis steadily becomes more intense; the pulse becomes steadily smaller, and at the same time unusually frequent and often even irregular; the extremities begin to grow cool to the touch; the râles become louder and louder, and even audible at a distance, as more and more mucus becomes accumulated in the larger bronchi; and finally death ensues under manifestations of sopor or asphyxia. In very rare cases eclamptic symptoms are observed shortly before death.

From this severe course, which is indeed but rarely observed, there are numerous variations. The greater number of cases progress under much milder manifestations; so that the febrile movements, cyanosis, severe paroxysms of cough, and the like, figure more as important features in the entire picture of symptoms, than as alarming evidences of the dangerous character of the disease. After the earlier and somewhat stormy manifestations have continued for a few days, they gradually subside, to disappear in complete recovery, or to leave behind for a certain length of time a few residual manifestations, or to pass into the chronic form of the affection.

The second form, *capillary bronchitis* proper, as is well known, is one of the most alarming diseases of infancy. It does not often begin suddenly with full severity in the midst of perfect health. Much more frequently, the disease appears in connection with measles, scarlatina, whooping-cough, and other diseases; or it appears as an ordinary catarrh (usually with coryza), which for a time is limited to the larger bronchi, and then suddenly or gradually becomes transmitted to the smaller and the minutest bronchi. It is also observed as a result of cardiac insufficiency, emphysema, anomalies of thoracic configuration, and the like.

Capillary bronchitis, as is well known, is a much more alarming disease in children and nurslings than in adults. This is due in great part to purely physical conditions, viz., the nor-

mally greater narrowness of the smaller bronchi, which readily become completely impervious under a moderate amount of swelling and accumulation of mucus.

The commencement of the disease, as above mentioned, is frequently but little marked. Capillary bronchitis is almost always associated with *fever* from the beginning. Where fever has already existed, it becomes increased with the extension of the catarrhal inflammation to the smaller bronchi. The *dyspnœa*, also, soon increases to a marked degree; the *breathing* is unusually accelerated and laborious; the number of respirations reaches sixty and more in the minute; the respiration is often but little effectual, despite the assistance of numerous auxiliary muscles, and it is subject to short intermissions. Evidences of disturbance in the circulation soon become added; the patient acquires a bluish, dull aspect, while the arterial pressure gradually sinks more and more; the pulse, at first full, becomes correspondingly small and much accelerated, and often but barely perceptible. The urine becomes scanty, and for this reason as well as owing to the diminished absorption of oxygen, uric acid is copiously secreted (Gerhardt).

The *cough* is at the same time severe and frequently repeated. Notwithstanding the severe paroxysms of cough, there is but little or no expectoration in most instances. In children it is swallowed for the most part. Where expectoration exists, it presents at first crude, tenacious, vitreous masses of mucus; and at a later period, sputa of a rather grayish-yellow color are discharged. Sweating is frequently observed.

Physical exploration furnishes important results only as far as regards *auscultation*. The respiratory murmur may fail entirely in places, and is masked particularly by the different kinds of *fine bubbling râles* mentioned in a former part of this article. It is sometimes possible to recognize, by percussion, dilatation of the right side of the heart, which has ensued as a result of extensive venous obstruction.

In many cases, especially in children, the symptoms of respiratory insufficiency increase in a short time to a very great degree; the dyspnœa steadily increases, and soon symptoms of asphyxia set in, under which the patient finally expires.

Death occurs, in most instances, with the well-known symptoms of carbonic acid poisoning.

One symptom more deserves particular mention here, a symptom which may by its gradual increase or decrease, furnish a diagnostic indication, and that is the condition of the *hypochondrium and the epigastrium.* As is well known, these parts in the normal condition are always distended on inspiration, and undergo retraction again with expiration ; of course in different intensity, according to age and sex. So long as a sufficient quantity of air can penetrate this most distant and lowermost portion of the thorax, these parts must undergo an inspiratory distention. But it is otherwise when a sufficient quantity of air cannot gain entrance. Then the rarefaction of the air with each inspiration can no longer compensate for this increased resistance to the entrance of the air, and this section of the thorax, as the furthest removed from the fixed point, must undergo an inspiratory retraction, which must extend the further upwards the more considerable the impediment to respiration. For this reason we see in every form of laryngeal and tracheal stenosis a varying degree of retraction of these parts ensue, sometimes greater and sometimes slighter, according to the degree of constriction. The condition is somewhat different in capillary bronchitis, as a matter of course. But if numerous bronchi of the lowermost sections have become impervious in consequence of swelling and accumulation of secretion, so that air can no longer penetrate into the alveoli to which they lead, then a retraction of these lowest sections of the thorax must follow also. If, therefore, in capillary bronchitis, the epigastrium and hypochondrium still undergo distention in the normal manner, we are justified in the conclusion that breathing still takes place in a manner relatively adequate for the purposes of respiration. In proportion, however, as these parts and larger or smaller portions of the thorax undergo inspiratory retraction, we are justified in concluding that larger or smaller bronchial districts have become impervious.

Seitz mentions still another important symptom of incomplete breathing that occasionally occurs, but which has as yet hardly attracted the attention it merits, and that is *the bulging*

forwards of the supraclavicular and infraclavicular regions, and the indistinctness of the respiratory movements in these sections of the thorax. Seitz correctly designates this pulmonary enlargement as distention of the lungs. Its origin is to be recognized in a distention of the pulmonary vesicles in consequence of the impeded egress of the air which has penetrated into them. I have already referred on a previous occasion[1] to this pulmonary distention in general, as occurring in the different forms of bronchitis. Donders especially, in his beautiful work[2] on the movements of the lungs and the heart in respiration, first appreciated these relations properly, though only in a general manner. In the act of inspiration the resulting increase in volume calls for a corresponding increase in the quantity of air supplied to the lung, and those pulmonary vesicles will be the first to undergo distention, which require the least tension for this purpose. This tension, however, as shown by Donders, may become so great as to lead to emphysematous dilatation of these parts.

If the capillary bronchitis tends to a fatal termination, this takes place, as a rule, within the first fourteen days. If it follows at a later period, it is usually due to some complication, especially the so-called catarrhal pneumonia. The younger and more delicate the child, the greater the danger, as a matter of course, and the more readily the disease under consideration may become fatal. But it is in just this class of cases that the magnitude of the danger is often first recognized only when the child has already begun to show signs of asphyxia.

Vigorous efforts to cough, which might still remove the mucus, are not made by children. The narrowness of the minuter bronchial ramifications renders it intelligible how they may rapidly become occluded, and then even all auscultatory signs may fail. The advanced cyanosis, mingled with the pallor of the skin, the sopor and delirium, the small, thready pulse, and similar indications often furnish the first evidence of the severity of the affection, which then in most instances leads to a fatal termination within a short time.

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[1] *Riegel*, Die Athembewegungen. Würzburg, 1873.
[2] Zeitschrift f. rationelle Medicin, Neue Folge, Bd. III., p. 39.

The older and stronger the child, and the better able he is to remove by vigorous coughing a portion of the accumulated secretion, the better the prospect of recovery.

If the disease tends towards improvement, as will naturally be the case in those instances in which the impermeability of the bronchi (owing to the presence of mucus and the swelling of the mucous membrane) has not involved too large an extent of the lung, and in which the power of the heart has not already been too much enfeebled, then the dyspnœa gradually diminishes, and the fever gradually subsides. Powerful efforts of coughing are made to remove a portion of the secretion; the cyanosis disappears as the air-passages become more pervious; the pulse becomes fuller again and stronger, and the pallid, livid aspect fades away. The respiration becomes freer; the râles, which have acquired the moist character, gradually become fewer and fewer, and thus the patient finally enters the stage of convalescence. Still, however,—and it is by no means a rare occurrence —a sudden fresh exacerbation of the symptoms may be observed, a relapse, to which, then, lobular catarrhal pneumonia is frequently superadded; and even though this complication may terminate favorably, it puts off the patient's ultimate recovery to a distant period. It is apparent then that the course of the disease may often be protracted, and even in its later periods sudden exacerbations and complications may not infrequently lead to a fatal termination.

The *diagnosis* of capillary bronchitis presents no particular difficulty in the majority of cases. It is readily made out from the greater or less degree of dyspnœa, associated with febrile movements, the frequent cough, without expectoration for the most part, the characteristic fine-bubbling râles, the absence of changes on percussion—the latter of special importance in enabling us to distinguish between this affection and lobular consolidation, though it cannot positively be relied upon, inasmuch as small broncho-pneumonic foci often cannot be demonstrated with certainty—the notable acceleration of the pulse, the cyanosis, associated in most instances with pallor of the skin, and finally the soporific manifestations and the like, in the later stages. The diagnosis presents difficulties, at the commencement

of the affection, only in very small, weakly children, in whom the cough is but slight, and by whom powerful efforts to get up the sputa are not made, so that the râles fail completely in a short time in consequence of the obstruction of the bronchi, and thus soporific manifestations soon become evident. The careful consideration of the above-mentioned circumstances would soon lead to a proper diagnosis even in such cases.

Finally, it is of importance to recognize at once the advent of a catarrhal pneumonia. Concerning the diagnosis of this condition, we must refer the reader to the chapter on catarrhal pneumonia.

III. *Chronic Forms of Bronchitis.*

Chronic bronchial catarrh appears either in a *genuine, idiopathic* form, or as a *secondary* affection in other chronic diseases of the lungs and in other affections, and especially often as a result of mechanical disturbance of the circulation. In the latter instance, it is easy to understand how mechanical disturbance of the pulmonary circulation exerts a retrograde action upon the bronchial vessels also.

As is well known, the circulatory apparatus of the respiratory organs is a special one. Not only the pulmonary arteries, but the bronchial arteries also, have a share in the capillary circulation of the lungs, and therefore, likewise, in disturbance of the nutrition of the tissues. The bronchial arteries course more interstitially, between the lobules, to ramify finally in the pleura, while the pulmonary arteries form the chief mass of the alveolar capillaries. Thus, therefore, peribronchial inflammations and parenchymatous pulmonary inflammations interest mainly the territory of the bronchial arteries; while, on the other hand, the superficial inflammations of the lungs interest the domain of the pulmonary arteries. This explains the participation of the pleura and bronchi in diseases originating in the parenchyma of the lungs, as well as the possibility of extension of diseases of the bronchial tract and pleura into the pulmonary parenchyma; and it explains, too, on the other hand, the cause of the regularity in the mode of manifestation of both classes of disease (Buhl).

Thus, for example, we see an especial disposition to chronic inflammation of the bronchial mucous membrane in pulmonary emphysema, as well as in nearly all the affections of the pulmonary parenchyma, and in insufficiency of the mitral valve and similar affections. In the second place, dyscrasiæ are to be

mentioned, as a result of which secondary bronchial affections are not infrequently observed. In like manner, severe constitutional diseases, especially infective diseases, loss of blood, and the like, occasion an increased disposition to catarrhal inflammatory affections of the bronchial mucous membrane.

Chronic bronchitis is frequently developed from the acute disease ; but it may creep on so stealthily from the commencement that an acute period cannot be ascribed to it. Concerning the special originating causes of chronic bronchitis, we refer the reader to what has already been said at the beginning of this chapter on the etiology of catarrh in general.

Chronic catarrh limited to the trachea alone is one of the most exceptional forms ; larger or smaller portions of the bronchial system being affected at the same time, as a rule. But whether the tracheal mucous membrane is affected alone, or in association with a portion of the bronchial mucous membrane, hardly any marked impediment to respiration is produced, at least in adults, even in cases in which there is considerable swelling of the tracheal mucous membrane. Symptoms of stenosis can be occasioned only where there is œdema and inflammation of the submucous connective tissue, where there is perichondritis, or where, as occurs especially in consequence of syphilis, a constricting, callous, or cicatricial formation has become developed from hypertrophy and induration, or from ulceration of this tissue. Concerning the manifestations of this condition, we refer the reader to the chapter on tracheal stenosis.

Cystiform degenerations of the mucous glands are sometimes observed in the trachea in chronic inflammations, and these may readily be mistaken for adherent mucus, on superficial laryngoscopic examination ; but their constant appearance at the same points, on repeated examinations, suffices to correct the mistake. As is self-evident, the symptomatic features of the disease would be as little altered by these degenerations as by slight erosions, epithelial exfoliations, hemorrhages, and the like, for which reason we will not present any special description of these affections of mere pathologico-anatomical interest.

As already mentioned, the exact determination of delicate

alterations of the tracheal mucous membrane is better accomplished by *tracheoscopy* than by auscultation and other methods of exploration; while by auscultation alone we are able to detect the implication of certain portions of the bronchi, and the limits to which the disease has extended.

The *symptoms* of chronic bronchitis coincide, in all essential points, with those of the acute form. As in acute catarrh, so here, also, numerous variations occur, which are in part due to the seat and extent of the disease, but more so to the nature and quantity of the secretion. The course of these forms varies in a measure according as the affection is of a genuine inflammatory nature, or secondary to some other disease, such as the various chronic affections of the lung, valvular insufficiency, and the like. We shall describe merely the more essential forms, inasmuch as the symptomatic picture, upon which exclusively the diagnosis rests, is the same for both varieties, and the modifications in the course of the latter are practically occasioned by the fundamental affection only.

Chronic bronchial catarrh, which is one of the most widely distributed affections among the working classes, may have its seat in the larger medium-sized, or smallest bronchial tubes. It is as a rule uniformly extended over both lungs, and especially over the *lower and middle portions of the lungs*, and principally in their larger and medium-sized bronchial tubes. It occurs in middle and advanced life more especially, and is observed in men much more frequently than in women.

The most prominent symptoms are *cough* and *expectoration*.

The differences in the expectoration afford the chief basis upon which a series of varieties of the disease may be established. Thus there are cases in which there is hardly any expectoration; others in which moderate quantities of sputa are discharged; others, again, in which considerable quantities of puriform sputa are expectorated. Not only do the auscultatory manifestations depend upon the consistence and quantity of the secretions, but also, in part, upon the frequency and severity of the paroxysms of cough, the manifestations of dyspnœa, and even the general condition of health.

The expectoration may be almost pure mucus, or more puru-

lent or more vitreous in consistence; it may be serous, it may be fetid, and so on. The amount and severity of the cough change in like manner. In many cases there is no characteristic dyspnœa at all; in others, especially in the more dry forms of catarrh, it is often considerable, and increases at times, even to severe suffocative or asthmatic paroxysms.

The *course* of these chronic bronchial catarrhs is most frequently as follows: Coming on either stealthily, as it were, without having been preceded by any special acute period, or else developed from an acute catarrh, the chronic bronchitis of adults occasions no special disturbances for a long time, even perhaps for years. It is only in the morning after waking that the patient experiences a more or less decided disposition to cough, attended with a slight sensation of constriction and oppression in the chest. He then coughs for a length of time, until the breathing has again become freed by the expectoration of a larger or smaller quantity of bronchial secretion.

Occasionally, and then only in cases of very mild character, and at the commencement of the disease, there is an entire absence of cough or further disturbance of any kind during the remainder of the day. In most cases, especially after a somewhat longer duration of the affection, a very slight degree of dyspnœa continues during the remainder of the day also. Any decided muscular effort will be pretty sure to excite dyspnœa at once. The cough is also repeated from time to time during the day, although to a moderate degree only; and expectoration is always followed by relief.

In the more severe and farther advanced forms, on the contrary, the disposition to cough and a moderate degree of dyspnœa persist almost continuously; so that the patient is annoyed day and night. Palpitations of the heart, and especially pains in the epigastrium, in consequence of enlargement of the liver, due to the disturbance of the circulation, are frequent causes of complaint in the severer and protracted forms of this catarrh.

At a relatively early period most patients with chronic catarrh complain of shortness of breath, which becomes especially troublesome on rapid walking, going up stairs, and so on. In the early stages the patient still feels tolerably comfortable

during the summer; and periods of complete health occur, especially if the patient is in a condition to take proper care of himself. The working classes, therefore, suffer much more, in consequence of such chronic catarrhs, than people of the better classes.

In winter the catarrh undergoes exacerbation again; palpitation of the heart becomes gradually superadded; the face, lips, nails, knee-pans, and other peripheric portions of the body gradually become more and more cyanotic; the cervical veins become swollen, and show undulating and even pulsating movements. At a later stage the feet swell, so that the patient cannot leave his apartment; and still later, when the dropsy gradually spreads lower down, and ascites occurs, he cannot even leave his bed. The urine gradually furnishes more or less decided evidences of the presence of albumen. Finally, a fatal termination ensues under increase of the dropsy and dyspnœa.

With reference to the results of *physical examination*, they hardly differ in any essential points from those mentioned in connection with acute catarrh, with the exception of a few consecutive alterations. *Percussion*, of course, not unfrequently shows deviations from the normal resonance; but these are not so much due to the chronic catarrh, as such, as to a very common resulting affection, *emphysema*. *Chronic bronchial catarrh, as such, never exhibits any deviations from the normal results of percussion.*

Auscultation reveals sometimes rough and harsh respiratory murmurs, sometimes weakened murmurs, and sometimes the murmurs are indistinct or fail altogether at certain localities. All these conditions may change, even within a very short space of time; and they are in no wise characteristic. The different sorts of *râles*, sometimes moist and sometimes dry, are of much greater importance. Their favorite seats in chronic catarrh are in the posterior and inferior portions of the lungs. Coarse and medium-sized bubbling râles are heard most frequently, and, to a certain extent, fine moist râles also.

Sometimes these râles, as well as the characteristic respiratory murmur likewise, disappear temporarily over a larger or smaller portion of the lungs, especially when the principal com-

municating bronchus is temporarily filled with secretion and occluded. Under these circumstances a forcible respiration, or a couple of powerful efforts of cough will often suffice to remove the obstructing secretion, and thus render the previous auscultatory manifestations again audible. In other cases only dry, whistling, and sonorous râles are heard, occasioned by severe swelling of the mucous membrane, and the presence of tenacious, scanty secretion.

Simple, chronic, bronchial catarrh is therefore distinguished from the tuberculous processes by its seat, and also by the manner of its extension. In its further increase it always appears to extend from below upwards; and it is especially the posterior inferior portions in which numerous râles can be discerned, while the anterior superior portions, especially the apices of the lungs, still maintain their normal conditions.

In this manner the disease progresses for years with frequent *remissions*, and even short *intermissions*. Even all the symptoms of disease may completely recede temporarily, as in summer, so that the patient considers himself cured. With the return of the unfavorable season, however, the catarrh begins anew, or undergoes exacerbation; and then it continues permanently, even in a more severe degree. With bronchial catarrh, however, in contradistinction to the tuberculous process, the general nutrition hardly ever suffers in an appreciable manner, even when the disease continues for years. The nutrition begins to suffer only upon the onset of severe cyanotic manifestations, dropsy, enlargement of the liver, and the like.

Of the remaining attendant manifestations, *fever* is still to be mentioned; and this, though by no means of regular occurrence, is sometimes observed, temporarily, in the course of chronic catarrh. Febrile movements, of course, do not belong to characteristic, chronic, bronchial catarrh as a rule. Not infrequently, however, acute exacerbations are observed in its course, which are sometimes associated with moderate febrile movements.

Of the remaining symptoms, especial mention must be made of the frequent occurrence of *moderate painfulness in the right hypochondrium and in the epigastric region.* Pressure in this

region also becomes painful in catarrhs of long continuance. This epigastric pain, which is a not infrequent cause of complaint, is connected with enlargement of the liver due to venous hyperæmia. Slight manifestations of *dyspepsia*, of chronic gastric and intestinal catarrh, are also sometimes observed in the later stages, as a result of the disturbed relations of the circulation. The appetite is often poor at this time, and the bowels are inactive. Occasionally diarrhœa is observed.

The moderate *albuminuria* which often occurs in the later course of the disease is also to be regarded as associated with these disturbances of circulation.

Other pains—severe thoracic pains especially—do not belong to the characteristic symptoms of ordinary chronic bronchitis. Sometimes there is pain in the chest in the region of the respiratory muscles, especially those of expiration, in consequence of the severe straining in coughing. If pleurodynia exists, there is reason to suspect some complication.

With regard to the further *course* of chronic bronchitis, its termination in complete recovery is observed only in very mild forms, and in cases of relatively short duration. *Termination in complete recovery must be regarded as the exception, and not as the rule.*

On the other hand, the temporary intermissions not infrequently observed in the course of chronic catarrh during favorable seasons of the year must not be regarded as actual recoveries ; for, under the influence of some slight injury, a slight cold, a wetting, or even without the influence of any special cause, merely with the approach of the inclement seasons of the year, all the symptoms promptly recur. There remains, therefore, even in very favorable cases, an unusual predisposition to such catarrhal affections.

The prospects of recovery are, as a matter of course, relatively more favorable in strong, youthful subjects than in weak individuals and those in the decline of life.

The severest forms of chronic bronchitis rarely terminate in recovery, but frequently enough lead, finally, to a fatal termination through a series of secondary affections ; although, for the most part, not until after very long duration. It is especially

through the disturbances of the circulation, which the bronchitis occasions—the hypertrophy of the heart with fatty degeneration at a later period, the dropsy, the albuminuria, and the like—that life is endangered.

Like emphysema, so, also, diffuse chronic catarrh of the air-passages becomes associated, as a rule, after long continuance, with *hypertrophy and dilatation of the right ventricle of the heart.*

Concerning the manner in which this hypertrophy and dilatation take place, there is as yet no uniformity of opinion. The cause assigned by Traube, however, that the absence of any very marked alteration of volume of the lungs in inspiration and expiration, as must necessarily be the case where the bronchi are obstructed, gives rise to unusual resistance to the pulmonary circulation, is likewise of important significance in the production of the latter condition.

If, in the course of chronic affections of the bronchial mucous membrane, there occurs a continuous and constantly increasing cyanosis, then it may be concluded with great plausibility that there is molecular alteration, in fact fatty degeneration of the muscle of the heart, especially of the right ventricle (Traube). The latter circumstance is due to insufficient oxygenation. The supply of oxygen to the walls of the right ventricle is impaired in a double manner : first, by the distention which the walls suffer with the increasing dilatation, which must diminish the calibre of the capillary blood-vessels in the walls, and thus the number of colored blood-corpuscles which pass over any one portion of the muscular fibres in a given space of time ; and second, by the impoverished condition of the blood in oxygen, resulting from the impediment to respiration (Traube).

We have already spoken of the altered *respiratory rhythm* and the *dyspnœa* which constantly attend chronic catarrhs. We have here but to mention the *hypertrophy of various muscles,* especially the sterno-cleido-mastoids, the scaleni, and others, which not infrequently results from the severe exertion of the respiratory muscles. The scaleni often become prominent as thick cords, alongside of which the much dilated and not infrequently undulating jugular veins course as thick bluish cords. These hypertrophied muscles are usually in a condition of moderate contraction and tension. The neck appears short and thick,

a condition which, in its higher grade, as is well known, is best observed in emphysema.

Having described the most important features and symptoms of chronic catarrh, it remains to pay special attention to some of its varieties. There is a great series of variations dependent upon the nature, quantity, and other peculiarities of the sputa ; and with these changing conditions of the sputa there is a change in the clinical picture, as could hardly be otherwise expected from what has been said above.

Under the designation " *dry catarrh*," Laënnec was the first to describe a form of bronchitis, which is distinguished symptomatically by severe paroxysms of cough and but a trifling amount of expectoration, despite exhausting and painful cough. Its seat is chiefly in the minuter bronchi, the mucous membrane of which is very hyperæmic, and swollen to a very great degree. The secretion is scanty, tenacious, sometimes translucent, but mostly grayish and turbid. The more extended this hyperæmia, the more considerable is the dyspnœa, and the severer the paroxysms of cough and the asthmatic troubles. This form is generally associated with the greatest distress, which is proportionate to the severity and extent of the affection.

This form, after long continuance, is frequently, if not always, combined with *emphysema*. It is not a difficult matter to comprehend the relations which associate emphysema with this chronic catarrh of the minuter bronchi.

The most important symptom is the *unusually severe and straining cough*, which often exhibits even a spasmodic character. Expiration especially is most markedly impeded. The paroxysms of cough are often so severe and associated with so much straining as to occasion vomiting. During these paroxysms of cough, the countenance often exhibits a dark bluish-red cyanotic color ; the jugular veins swell into thick, bluish cords ; but, despite the severe paroxysms of coughing, it is only after prolonged and painful efforts that a little viscid mucus can be expelled, owing to its tenacity and its deep seat in the minuter bronchi.

The laborious respiration is especially pronounced in children with dry bronchitis. The respirations are often as frequent as

from forty to eighty in the minute; and there is great anxiety and restlessness with it, as in croup; so that the children will not remain in bed. Expiration is chiefly affected, and is accomplished in jerks, or is more prolonged than natural. Asthmatic paroxysms often occur. All the respiratory muscles are in strained activity. There are frequent paroxysms of cough, similar to those of whooping-cough, and there may be either no expectoration at all, or only a very little. Auscultation reveals no mucous râles, but only harsh respiration, and dry rhonchi. There may be but slight fever, or none at all. Symptoms of hyperæmic stasis of the brain may occur in cases of long continuance. The disease usually terminates fatally in children, after a chronic course of at least several months.

The physical symptoms of this form of catarrh are often associated with those of emphysema, inasmuch as it becomes complicated with the latter condition after long continuance. Sibilant, whistling, dry rhonchi, with sometimes harsh, and sometimes diminished respiratory murmur; forced respiration with preponderating, prolonged expiration, extending beyond the normal limits of the lung in cases of marked dilatation of the vesicles; sonorous resonance on percussion, which, especially in the lower, posterior, and lateral portions of the lung, in cases of vesicular dilatation consequent upon excessive distention of the alveolar tissue, often exhibits that modification designated by Biermer[1] "bandbox-tone" (Schachtelton); excessive development of the expiratory muscles, even barrel-shaped distention of the thorax under some circumstances;—these are the most important symptoms observed in severe cases complicated with emphysema.

This dry catarrh is a very obstinate affection, and may persist for many years, although there may be remissions. Almost every variety of catarrh undergoes certain changes in the course of time, and so in this form the character and the amount of the secretion are apt to change. Thus for a longer or shorter period there will be produced an abundant secretion richer in cells, or more serous, in the place of the scanty, tenacious sputa usually

[1] Ueber Bronchialasthma. Sammlung klinischer Vorträge, herausgegeben von R. Volkmann, 1870. (See also Vol. V. of this Cyclopædia, p. 387.)

secreted. As already mentioned, this form, when of long dura-
tion, becomes readily combined with pulmonary dilatation and
emphysema. When, on the other hand, the occlusion of the
minuter bronchi is complete, atelectasis and collapse of the
alveoli ensue.

It is advisable, in the second place, to distinguish *a so-called
mild form of chronic bronchitis with moderate mucous expec-
toration*, in which the symptoms are much milder in character
than those of the first-mentioned form. This form is observed
at every period of life, but most frequently in middle and
advanced age. It is an especially frequent disease of the work-
ing classes in middle life, and it is chiefly those employments
previously mentioned as attended with the development of dust
which frequently occasion it. It is also observed in childhood,
especially in scrofulous, rachitic, and poorly nourished children ;
and it readily occurs in the wake of acute infantile diseases,
especially measles and whooping-cough.

Manifold variations are observed according to its etiology, the
age of the patient, his constitutional vigor, and so on. Its
course is, in general, by no means violent. Such patients cough
in spring, winter, and autumn, especially, while they have little
or no cough in summer. They cough up moderate quantities
of mucous sputa, and expectoration is generally easy. Apart
from the cough, such patients are tolerably well ; their general
health does not suffer, at least for a long time. Febrile move-
ments do not occur, or are only observed when some acute
exacerbation becomes suddenly manifested.

Physical exploration reveals no alteration of the normal type
of respiration, and no alteration of the percussion pitch ; only
at times are more or less numerous rhonchi heard in the coarser
and medium-sized bronchi.

This form of the affection may retrograde in its course, but
more frequently it continues for years ; and it may gradually
extend to larger sections of the bronchial tract, and readily
become combined with diseases of the pulmonary parenchyma.

Besides the forms of bronchial catarrh already mentioned,
there are others, which, in contradistinction to those described,
are distinguished by an *excessive amount of expectoration.*

In view of the special differences in the expectorated masses, two further forms may be distinguished, namely, the characteristic *broncho-blennorrhœa* and the *serous bronchorrhœa* (the pituitous catarrh of Laënnec).

First, as regards the characteristic *broncho-blennorrhœa*. It is characterized by the discharge of copious quantities of puriform mucus, and this discharge has been improperly designated as purulent flux of the bronchi. It usually occurs in a chronic form, but is sometimes encountered as a more acute affection. Broncho-blennorrhœa is observed in its most pronounced form in bronchiectasis.

The symptoms, for a long time, are chiefly those of an ordinary chronic bronchial catarrh. After the prolonged duration of such a chronic catarrh, or after repeated acute catarrhs, the pronounced features of broncho-blennorrhœa become developed. The muco-purulent secretion gradually becomes more copious and purulent, the cough more frequent and severe, and then, from time to time, larger quantities of these purulent sputa are expectorated. The sputa thus expectorated may amount to a very considerable quantity. The patient suffers most from shortness of breath, which from time to time reaches an aggravated degree. After successive expectorations there is usually more comfort, and the dyspnœa diminishes. The patient soon becomes emaciated. There is usually impaired appetite and disturbed sleep. Febrile movements frequently occur. The emaciation is explained by the great loss of fluids occasioned by the copious expectoration; and it has long been known as a fact that pus stagnating in the bronchi may give rise to fever. The stronger the affected individual is originally, the more readily and the longer can he sustain this great loss of fluids; but eventually he nevertheless becomes emaciated, a more or less severe degree of anæmia and cachexia becomes developed, and finally, even a fatal termination may ensue, often after the development of dropsical manifestations. In rare cases the broncho-blennorrhœa may be cured, all the symptoms undergoing gradual amelioration, and giving place to a simple chronic catarrh.

The second form of bronchorrhœa, which we have designated

as *serous bronchorrhœa*, has already been described by Laënnec under the name of *"pituitous catarrh."* The characteristic of this form of chronic bronchial catarrh is the copious serous secretion, poor in cells, which is expectorated under severe paroxysms of cough. The expectorated matter consists of a tolerably colorless, thready fluid, containing but few cells, which, when observed in the spittoon, bears a good deal of froth on the surface, and has but a few flakes of mucus mixed with it. The expectoration of these masses, which often amount to a considerable quantity, is usually accompanied with very severe and straining efforts of cough ; and at the same time there is a good deal of dyspnœa, which is somewhat relieved after the discharge of the masses. On account of the very marked want of breath and the asthmatic difficulties, this form has been described as a special form of asthma,—humid asthma.

Pituitous catarrh occurs, as a rule, as a chronic affection, which becomes gradually developed like the other forms of catarrh already mentioned. Severe attacks of dyspnœa and paroxysms of cough are observed, as in characteristic bronchoblennorrhœa. They recur at irregular intervals, most frequently during the morning. The paroxysm of cough and the dyspnœa moderate or cease entirely after the expectoration of sputa in large quantity ; but in most instances the patient is at least not entirely free from all dyspnœa during the intervals.

Physical examination reveals nothing beyond the results already mentioned. Numerous râles are heard, chiefly the moist, coarse, and fine bubbling ones. Febrile symptoms are not observed, as a rule, in this form of chronic bronchial catarrh.

As already mentioned, the quantity of the expectorated secretion is in many cases very great ; it may amount to several pounds daily. Despite this, the resulting emaciation is often but slight, even after long continuance of the trouble. Laënnec narrates the case of a patient seventy years of age—also cited by Biermer—who for ten or twelve years expectorated about four pounds of such sero-mucous sputa daily, and yet continued to be tolerably well.

Only after a long time does emaciation occur, and then usually it is not very considerable. Complete recovery is rarely

observed.   The fatal termination is usually occasioned by super-added complications.

As the last variety, we have to mention, finally, *fetid* or *putrid bronchitis*, which sometimes occurs as a chronic affection and sometimes as an acute one.   Fetid expectoration is observed most frequently in gangrene of the lungs, in saccular bron-chiectasis, and in perforating ichorous empyema of the lungs. There are also fetid sputa in cases in which none of these condi-tions exist.   Even in diffuse bronchial dilatation, the secretion from the bronchial mucous membrane may undergo fetid decom-position under certain circumstances; and even without this condition the bronchial secretion may in certain cases acquire the character mentioned.   In what follows we are concerned only with these latter forms.

As especially stated by Lebert, the knowledge of fetid bron-chitis is not confined to recent times, as is generally supposed; indications concerning it are to be found in older literature. Observations of the kind are to be found recorded by Laënnec,[1] Andral,[2] and Briquet.[3]   Laycock,[4] in 1857, reported several cases of putrid bronchitis.   Our knowledge of fetid bronchitis, how-ever, has been most enlarged by Traube,[5] who first showed with special distinctness that the expectoration of putrid masses is by no means always associated with the existence of bronchiectasis, gangrene of the lung, and the like, and that it may also be observed in simple bronchitis.

Lebert, also, who has devoted a special description to putrid bronchitis, in his recent manual of diseases of the chest, relates that he has observed fetid bronchitis under very different condi-ditions, sometimes as a primary affection, sometimes as a secon-dary one, sometimes only as a temporary accident in bronchitis, bronchopneumonia, and diffuse pneumonia, and sometimes as an essential form of bronchitis, without any other differential

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[1] Traité de l'auscultation.   Paris, 1819. 4. édit., 1837.

[2] Clinique médicale.   Paris, 1834, T. III., p. 2, 131.

[3] Archives génér. de méd., III. Série, T. XI.   Paris, 1841.

[4] Med. Times and Gazette, May, 1857.

[5] Deustche Klinik, 1853, p. 409; 1861, No. 50; and Gesammelte Abhandlungen, II. Bd., 556 and 684.

character than the foul odor of the sputa. On the whole, the
fetid condition of the secretion is but occasionally observed in
the idiopathic variety of bronchitis.

Concerning the *etiology* of this form, it is worthy of mention
that the disease comes under observation in the summer months
chiefly. It is frequently observed as a secondary complication
of pulmonary affections, especially tuberculosis, chronic pneu-
monia, bronchiectasis, and the like.

On the other hand, pulmonary gangrene proceeds not infrequently from putrid
bronchitis, from erosion and mortification of the bronchial walls and the surround-
ing pulmonary parenchyma. Sometimes the pulmonary gangrene leaves behind it
secreting cavities, communicating with the bronchi, in which the secretions stagnate
or undergo putrefaction; in other words, the gangrene of the lungs, after becoming
healed, leaves behind a sort of chronic putrid bronchitis (Leyden).

The final grounds why putrefaction of the bronchial secretions should take place
within the bronchi in the variety of the affection under consideration, is not satis-
factorily explained by the deserving labors of Leyden and Jaffé,[1] nor by the
hypothesis of the influence exerted by animal or vegetable organisms in the manner
indicated by Pasteur. Neither can the dilatation of the bronchi and the stagnation
of the secretion be regarded as the sole inciting causes.

Concerning the *expectoration*, its great similarity to that of pulmonary gangrene
is to be especially noticed. We believe it best to describe it here in Traube's own
language:[2] "The foul smell of the sputa, their great quantity, their turbid greenish-
yellow color, their disposition, in consequence of the great fluidity of the menstruum,
to separate after a time into three layers (an upper greenish-yellow, non-transparent,
frothy layer; a middle transparent, albuminous layer of serous consistence; and a
lower yellow, non-transparent layer, which having all the appearances of a pure
purulent sediment, consists of swollen pus-corpuscles and their detritus), and finally,
the presence in the sputa of soft, turbid, yellowish-white plugs, varying from the
size of a millet-seed to that of a bean, with smooth surfaces and of exceedingly foul
odor, in which microscopic examination reveals putrid animal substances and needles
of sebacic acid, as first described by Virchow,—all these are manifestations which
may occur in bronchial catarrh with dilatation of the bronchi, as well as in gangrene
of the lungs. The presence of such sputa merely shows that a process of decompo-
sition is taking place within the respiratory apparatus. The question is, however,
whether this putrefactive process takes place in the interior of intact bronchi, or
whether it is associated with destruction of the pulmonary parenchyma. Only
where the latter condition can be determined with certainty can we come to the

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[1] Ueber putride Sputa nebst einigen Bemerkungen über Lungenbrand und putride
Bronchitis, Deutsches Archiv für klin. Medicin, Bd. II., p. 488.

[2] Deutsche Klinik, 1853, p. 410.

conclusion that there is a process of decomposition in the parenchyma of the lungs, analogous to putrefaction or identical with it; that is to say, that there is gangrene of the lung."

Leyden [1] speaks concerning this point, as follows: " The evidence of destruction of the parenchyma of the lungs is afforded by the presence of parenchymatous detritus, that is, portions of the decomposing lung-tissue. They are, as described by Traube, enclosed in grayish-yellow masses, with shreddy borders, of a dirty aspect, consisting of an elastic, transparent, colorless ground substance, in which there are to be found a good deal of finely granular detritus, numerous yellow fat globules, here and there masses of free black pigment, and numerous large needles of sebacic acid. Elastic tissue is nowhere to be found (Deutsche Klinik, 1859, No. 46; and Gesammelte Abhandlungen, II., pp. 451 et seq.). The plugs of Dittrich also occur in the sputa of pulmonary gangrene, as well as in putrid bronchitis. These consist microscopically, according to Traube, of a detritus composed of extremely fine granules with larger fat globules. Not infrequently, as first described by Virchow, they contain needles of margaric acid."

Traube [2] distinguishes four stages of these plugs: 1, At the commencement of the affection they are white, still consist in great part of pus-corpuscles, with which the masses of detritus mentioned above are mingled; 2, At a more advanced stage the plugs show a dirty gray color, and numerous particles of a detritus strewn with larger fat globules are disseminated throughout a purulent mass; 3, In the third stage the clots have likewise a dirty gray color, and consist in greater part of the same sort of detritus as in the second stage; in addition, short, delicate needles, besides the fat-globules already mentioned, are distributed throughout it; 4, In the fourth stage the clots are still dirty gray, and the detritus contains large fat globules, and long thick needles, mostly united in bundles, which become varicose by pressure exerted upon the glass cover. This gradual internal development of the clots favors the hypothesis advanced by Traube, that special animal or vegetable organisms must be contained within them, which induce the process of putrefaction in the bronchi in the manner shown by Pasteur.

Of especial importance as regards the origin and nature of the putrefactive processes under consideration, is the constant occurrence of certain fungi in the shreds of gangrenous lung-tissue, and in the putrid clumps, as principally authenticated by Leyden and Jaffé.

A recent observation of Rosenstein [4] is worth mentioning in this connection, and that is, that he has found the threads and also the lancet-like cells of Oïdium albicans in the sputa of a patient with putrid bronchitis. Inasmuch as a patient with thrush lay near this patient, the influence of the fungus of the Oïdium appeared to be the direct occasion of the putrescence.

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[1] Ueber Lungenbrand. Sammlung klinischer Vorträge, No. 26, p. 200.

[2] Gesammelte Abhandlungen, II., p. 686.

[3] Deutsches Archiv f. klin. Med., 1866, Bd. II., pp. 488–519.

[4] Berlin. klin. Wochenschrift, 1867, No. 1.

The chemical examination of the sputa, instituted by Jaffé, revealed volatile fatty acids, especially butyric and valerianic acids, ammonia (though not constantly), sometimes hydrosulphurous acid, leucine, tyrosine, and traces of glycerine. Thus the analogy between this process and the ordinary process of decomposition seems to be substantiated.

In considering more closely the remaining clinical symptoms of fetid bronchitis, the *fetid breath* of the patient is to be mentioned in the first place. The patient's breath often exhales a still more penetrating odor than the sputum already expectorated. Concerning the first appearance of the fetid condition of the sputa and the breath it is to be remarked that this metamorphosis is stealthily and imperceptibly developed out of an ordinary bronchitis. It occurs more suddenly only in rare cases.

Physical examination of the thoracic organs gives *no other results than those corresponding to ordinary bronchitis;* but this very circumstance furnishes an important differential point in contrast with pulmonary gangrene and other diseases.

As a rule, there is always a reaction of the putrefactive process upon the general constitution. In most instances *fever* occurs within a short time, with considerable elevation of temperature and acceleration of pulse; and the strength may diminish to a considerable degree in a very short time. In mild cases the fever and other general symptoms subside, after a short time, with the improvement in the local process. It must not be forgotten, however, that in not a very small number of cases this putrefactive process may be sustained by the organism for some time without occasioning any very serious disturbances, as also happens in certain cases of undoubted gangrene of the lung which pursue their course without any febrile movements.

A further danger of this putrid bronchitis resides in the possibility of its extension upon the parenchyma of the lungs, in which case the entire picture of veritable pulmonary gangrene becomes developed. In other cases only the bronchial walls become irritated by the putrid secretion, and then inflamed, superficially excoriated, and necrosed. The putrefactive products in the bronchi may even give rise to diphtheritic processes in the bronchial mucous membrane (Traube). Accordingly, with the exception of the expectoration, there are no further positive

characteristic manifestations of fetid bronchitis. The micro-
scopic examination of the sputa is specially important, as fur-
nishing the results already described.

Discrimination of this affection from empyema perforating
the lung, is easier than discrimination between pure putrid bron-
chitis and gangrene of the lung. The symptoms previous to the
rupture, the sudden appearance of large masses of sputa, the
quality of the expectoration, the sudden change in the physical
symptoms, all protect against such a mistake.

Discrimination of simple putrid bronchitis from bronchi-
ectatic cavities is more difficult. The sputa furnish no indica-
tions; but the physical symptoms are a better guide; for in
the former instance the signs are only bronchitic, while they are
cavernous in the latter. As a matter of course, circumscribed
dulness or cavernous symptoms are only found when consider-
able bronchiectatic conditions are situated close to the thoracic
walls.

Another and more important sign for discriminating between
them exists in the nature and manner of the expectoration. In
bronchiectatic cavities, severe accesses of cough, repeated at
shorter or longer intervals, by means of which considerable quan-
tities of putrid sputa become ejected at once, are almost pathog-
nomonic. These patients cough but little in the intervals as a
rule, and sputa then expectorated are often of a simple catarrhal
nature only. It is otherwise in fetid bronchitis, whether it is
associated with diffuse bronchial dilatation or not. Here there
are no severe paroxysms of cough, repeated at shorter or longer
intervals and attended with the copious discharge of fetid sputa;
but little sputum is discharged at a time, the individual spasms
of cough follow at relatively short intervals, and the sputa
thus discharged always show the same consistence as already
described.

In the mild forms recovery often takes place after a short
period. Slight grades of fetid mucus are not infrequently
observed as a temporary condition in various affections. Severe
grades may terminate fatally in a very short time. In the genu-
ine forms, when secondary gangrene of the lungs, or some other
complication does not occur, the course is often protracted.

Concerning the ultimate cause of fetor of the bronchial secretion, we must again repeat, in conclusion, that it is not yet sufficiently explained, despite the valuable contributions of Traube, Leyden, Jaffé, and others. We can, therefore, only coincide with Lebert, when he says that from a clinical standpoint fetid bronchitis can only be classified as a characteristic variety of pulmonary catarrh, and that the putrid decomposition of mucus resembles more a general pathological occurrence than a special form of disease. "Its fundamental character is fetid mucus, which may occur under manifold conditions, and the products of which we know tolerably well chemically and microscopically, but concerning the ultimate cause and special occasion of which we know tolerably little."

Complications and Sequelæ.

We have already alluded to the most important consecutive diseases and complications in describing the individual forms, so that their special elucidation appears unnecessary. We, therefore, recall attention only to the frequent complication of the different forms of bronchitis with *analogous diseases of the throat*, and especially of the larynx and trachea ; further to the *hypertrophy and dilatation of the right heart*, developed secondarily, as a result of the disturbed relations of the circulation ; to the *swelling of the liver*, the secondary *affections of the kidneys*, *dropsy*, and so on.

All the last-named complications are to be regarded only as the direct and necessary results of the disturbed circulation. Their occurrence is favored by the impeded return of the venous blood in consequence of the prolonged and difficult expiration, and the frequent spasms of coughing ; as well as by the absence of any considerable alteration of volume of the lungs in inspiration and expiration, in consequence of the bronchial obstruction. At first there is but slight *cyanosis*, which becomes specially marked during severe paroxysms of coughing. Gradually, however, the jugular veins become more and more distended, and exhibit undulating, or even pulsating movements. These disturbances, which result from over-filling of the pulmonary artery

and the right heart, are compensated in great part, for a time, by eccentric hypertrophy, to which dilatation of the right ventricle and auricle becomes superadded. Soon, also, the results of the disturbed circulation become evident in the domain of the lower vena cava. The evidences of obstruction in the *liver* are recognizable by the physically demonstrable enlargement of the organ. The consequences of the disturbed circulation may also extend to the *kidneys*, the *digestive tract*, and the like. The quantity of urine becomes diminished, its color darker, its solid constituents relatively increased, and its specific gravity higher. With a still greater degree of obstruction the urine becomes albuminous, and contains blood-corpuscles, casts, and even fatty-degenerated epithelium. These consequences of the disturbed venous circulation appear in a marked degree, when, as occurs in the latest stages, the commencing fatty degeneration of the hypertrophied right ventricle acts as an obstacle to the performance of the increased amount of work.

The alimentary canal also evinces signs of the disturbed circulation. Loss of appetite, regurgitation of food, meteorism, and irregularity of the stools are symptoms frequently observed at this time.

Gradually, too, dropsy becomes superadded, beginning at the ankles, and always extending from below upwards ; even ascites, hydrothorax, and the like, gradually make their appearance.

In severe cases these results of the disturbed circulation may exert an influence upon the brain. This is shown in syncope, noises in the ears, flashes before the eyes, indisposition to intellectual exertion, headache, and so on. In the last stage these symptoms of overfilling of the brain with blood may even increase to actual coma and stupor.

We have learned, further, that *catarrhal pneumonia*, and *collapse of the lung* are among the most frequent complications of capillary bronchitis.

Inflammatory affections of the pleura are less frequently observed as consecutive diseases or complications.

If an individual is predisposed *to tuberculosis*, this disposition is increased by repeated catarrh.

Bronchiectasis and *emphysema* are to be mentioned, further,

as frequent sequelæ. The nature and mode of their occurrence offer no further difficulties after what has been previously stated.

Spasm of the glottis is also observed as a temporary trouble, in most instances lasting only for a brief time and favored by the severe paroxysms of cough. On the other hand, I must decidedly deny that the severe manifestations of stenosis, such as are suddenly occasioned by spasm of the glottis, are ever occasioned by a sudden paralysis of the dilators of the glottis. The latter leads to manifestations of dyspnœa only after a long time, inasmuch as the antagonistic contraction of the closing muscles of the glottis is always developed gradually, as I have had opportunity to demonstrate clinically as well as experimentally.

That with the frequent recurrence and prolonged duration of such catarrhs, the disposition to analogous affections, especially of the pulmonary parenchyma, becomes greater, requires no further mention.

Diagnosis of Tracheitis and Bronchitis.

The diagnosis of tracheal and bronchial catarrh presents, in general, no special difficulties. Pure tracheitis, confined to the trachea alone, is, on the whole, very rarely observed. As a rule, the catarrhal inflammation extends from the trachea to the primitive bronchi, or the tracheitis occurs as an extension of catarrhal laryngitis. The discrimination between a laryngitis and a tracheitis is chiefly based upon alterations in the voice, and upon the appearances found by a laryngoscopic examination. A laryngoscopic, that is to say, tracheoscopic, examination can alone enable us to distinguish with certainty between a simple catarrhal inflammation of the trachea, hypertrophy of the mucous membrane, in which the mucous glands especially are often hypertrophied to a great degree, hemorrhages, slight forms of syphilitic disease, and the like. The latter, especially in their earlier stages, can only be safely diagnosticated by the aid of the mirror; while, in their severer forms, they are very apt, as is well known, to be associated with well-marked evidences of stenosis. The absence of a special symptomatic picture of these light forms of disease makes it impossible for us to devote any

separate description to them; the same is true of the secondary congestions, swellings, nodular, pustular, and even ulcerous formations occurring in the wake of various infective diseases. How important the examination with the mirror is for the recognition of these mild syphilitic and other diseases of the trachea, is particularly shown by the knowledge of the occurrence of condylomata which was first acquired by Seidel.[1]   Small, soft ulcers, analogous to the slight superficial ulcerations which affect the pharynx and larynx in the secondary period, occur in the trachea also.   Very frequently, indeed in most instances, these manifestations are combined with similar evidences of laryngeal disease.

In contradistinction to the secondary forms mentioned, which are recognized in part by aid of the mirror, and in part by the evidence of other symptoms of the affection, the diagnosis of tracheo-bronchitis, as well as of the other forms of bronchitis in general, offers no special difficulties.   The diagnosis rests upon the physical symptoms, the character of the sputa, the absence of dulness on percussion, the various forms of râles, and similar indications.   The discrimination of this affection from purely nervous paroxysms of cough, and those occasioned by diseases of the larynx, does not present any special difficulty.

The decision of the question whether a bronchial catarrh is to be regarded as an independent affection, or as a symptomatic and secondary one, is often more important and more difficult. Here, at least when the secondary diseases of the heart, liver, kidneys, and the like, are strongly developed, the careful consideration of each indication, especially when taken in connection with the history of the case, can alone lead to accuracy in diagnosis.   The discrimination from commencing tuberculous processes is also of great significance.   Concerning the discrimination between these forms we must refer the reader to the differential diagnostic data laid down in the chapter upon phthisis. In such cases the most scrutinizing examinations, the careful observation of the temperature, the observation of the condition of the general system, the consideration of the weight of the

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[1] Jenaische Zeitschrift, II., 4.

body, etc., are requisite to lead to a proper conclusion. Examination with the spirometer and the pneumatometer may also be of use here.

Space does not permit me to go any further into the consideration of these affections, and I must therefore refer the reader to the appropriate chapters.

The physician will not be likely to confound the disease with laryngeal affections and with whooping-cough if he makes a careful examination and gives due consideration to all the symptoms. He will be more likely to confound a capillary bronchitis with catarrhal pneumonia. The special points of significance here are: a further increase of temperature, coincident with the onset of the pneumonia (Ziemssen); the absolute elevation of temperature; the degree of dyspnœa; a stronger inspiratory retraction of the lowest portion of the costal arch; the evidence of circumscribed dulness of slight extent; and so on.

On the other hand, the differentiation of the individual forms of bronchitis, with reference to seat and extension, presents no difficulties. As regards the differential data of fetid bronchitis, on the one side, and pulmonary gangrene and similar forms, associated with putrefaction of the sputa, on the other, we have already made reference to them in describing the symptoms of the first of these forms of disease.

The frequent complication of chronic bronchial catarrhs with pulmonary dilatation and emphysema, presents no special difficulties as regards the diagnosis.

Terminations, Prognosis.

The prognosis of the individual forms of tracheitis and bronchitis varies very much.

Tracheal affections offer in general a favorable prognosis, as long at least as they are limited to the mucous membrane alone. *Simple catarrh of the mucous membrane of the trachea never gives rise to severe manifestations of stenosis.* Severe manifestations of stenosis can be occasioned only where the sub-mucous tissue, and the cartilages, are simultaneously diseased; these conditions furnishing a correspondingly less favorable prognosis.

In *simple acute bronchitis*, especially when limited to the coarser and medium-sized bronchi, the prognosis is almost always favorable. This form of the disease can only prove dangerous in very small children, in nurslings, in aged subjects, and in persons much debilitated by previous diseases.

Capillary bronchitis, on the contrary, is always a serious affection, which may frequently lead even to a fatal termination in small children and in aged subjects. It may be said, in general, that *the younger a child affected with capillary bronchitis, the greater the danger.* In the same manner *the danger increases* in small children, *in proportion to the extent of the catarrhal inflammatory processes, and the height of the fever.*

While, however, the acute fever mentioned hardly entails danger to life, except in children and the aged, the question as to complete restoration of health can hardly be answered in general. A great disposition to relapse very frequently remains as a residuum of such acute attacks of tracheo-bronchitis or diffuse catarrhs, from which chronic bronchitis may become eventually developed.

In chronic catarrhs the genuine forms must be separated from the secondary ones ; in the latter, as a matter of course, the fundamental disease determines the prognosis. In general, the prognosis in chronic catarrh is on the whole unfavorable, inasmuch as it is usually severe and often incurable ; but at the same time it may continue for years and decades without entailing any important injurious influence upon the general system. As in many other affections, here, also, the *external condition* of the patient is of great significance, inasmuch as people in the better conditions of life, who are able to avoid external injurious influences, and to protect themselves from them, are able to withstand the secondary consequences for longer periods than the less favored and poorer working classes, of whom, as is well known, a great number finally perish from these affections ; usually, however, in consequence of further morbid changes, due to the disturbed activity of the lungs, especially in the heart, kidneys, liver, and other organs. Such chronic bronchial catarrhs may also become dangerous, by leading to emphysema, bronchiectasis, and so on.

The general vigor and *age* of the patient are of not less importance, as regards the prognosis, than his external surroundings. Nurslings and small children are by their age seriously endangered by bronchial catarrh, and the danger increases with the volume and extent of the catarrh, and with its spread into the smaller and smallest bronchi. The danger of even a simple bronchitis increases in like manner in the later stages of life, and in the lungs of old persons it may even lead to a fatal termination.

In individual cases the amount and proximity of danger are always to be judged of by the degree of the manifestations of poisoning by carbonic acid gas. As long as these are not present, no immediate danger is to be apprehended. On the other hand, the symptoms of acute poisoning by carbonic acid gas may often become developed in an exceedingly short time, as, for example, in the capillary bronchitis of children. In individual cases, the following signs may be considered as especially unfavorable: small and empty pulse; superficial, but much accelerated respiration; severe degrees of cyanosis, sopor, delirium, and severe cephalic symptoms in general; the absence of expectoration, or at least difficult expectoration.

TREATMENT.

Prophylaxis.

Important as prophylaxis may appear in view of the great extent and frequency of bronchial catarrh, yet the avoidance of many injurious influences which are known to often give rise to it, and to keep it up when already existing, will always remain a *pium desideratum* with certain classes of people. This is the case, for example, with those who are frequently compelled to face inclement weather in the pursuit of their avocations. Another set of injurious influences, those connected with the presence of dust and other impurities in the air, can hardly be completely overcome by the means at our disposal.

An important advance in this respect has been made in modern times by the closer study of the connection of individual avocations with certain diseases; and,

as is well known, the study of diseases due to the inhalation of dust has occupied special attention. It is not our province here to mention all the precautions required in individual employments against the respiratory diseases occasioned by them and against the various forms of thoracic catarrh. We refer the reader, on this head, to the admirable monograph of Hirt.[1]

It cannot be denied, on the other hand, that, from another point of view, there are a series of important prophylactic measures, which certainly tend to strengthen the organism in general and render it better able to resist such influences. These prophylactic measures are to be employed from early youth.

I must here again recall the observations of Geigel,[2] already cited, which show that comparatively more well-born children die of respiratory affections in the first year of life than those less favored; while the latter class die in greater numbers from diseases of nutrition. The deaths from respiratory diseases are more frequent in the months of March, April, and May, while diseases of nutrition sacrifice most of their victims in the months of June, July, and August. The latter circumstance is due, without doubt, to the influence of depraved nutrition, to which children born under the least favorable conditions of life are naturally more exposed than are the well-born, and especially so in the warm season. On the other hand, the preponderance of respiratory diseases in the more favored children of the better classes can only be referred to their greater effeminacy.

This conclusion might perhaps be objected to on the ground that these children of well-to-do people are naturally feebler, and therefore exhibit an increased disposition to respiratory diseases. This objection may, it appears to me, be justly dismissed. We are not contrasting the children of the peasantry, on the one hand, and the children of residents in cities on the other. Here the objection is certainly true that the greater resistance of country-people depends not only upon their hardiness, but still more upon their naturally stronger constitutions. The distinction referred to here is between children of well-to-do parents, on the one hand, and, on the other hand, the children of poor people, likewise living in cities, but under the worst external conditions. If these latter, despite their unfavorable external relations, and despite their poor nutrition, suffer much less from respiratory diseases than those of the former class, the conclusion previously mentioned, that the cause lies in the greater effeminacy brought about by anxious mothers is certainly justifiable.

In this sense a certain, but, as a matter of course, not too vigorous toughening of the children must be recommended even at a relatively early period of life. This toughening must be

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[1] *Hirt*, Die Krankheiten der Arbeiter.   Breslau, 1873.
[2] Deutsche Vierteljahrsschrift f. öffentl. Gesundheitspflege, III., 520.

regulated in accordance with the condition of strength of the child; and where a naturally feeble constitution has occasioned a greater proneness to catarrhs in general the so-called hardening method alone will not accomplish the purpose. Here, corroborant treatment is much more important. Special toughening methods are not suitable during the earliest childhood, at least during the first year of life, in the case of children naturally very feeble. Here the prominent indication is for strong nourishment and protection from exposure to taking cold, and other external injurious influences. The children should not be taken into the open air in raw, windy, and rainy weather; and they must be carefully protected from draughts. On the other hand, a judicious strengthening by means of cold washing, douching, rubbing, and the like, when carefully practised, is much to be recommended when the children are somewhat further developed, and the stronger they are naturally, the earlier may it be practised. So long as such children have not attained a certain degree of vigor, so long as their feeble constitution affords them but little power of resistance against ordinary external injurious influences, the greater is the indication for improved nutrition. On the other hand, at a somewhat later period, the various methods of invigoration, by cold baths and cold washings, especially in the mornings, play an important part. As with children, so with adults also, these are invaluable means for strengthening the external integument. It is by no means to be said, however, that invigorating measures shall not be employed with small children. The contrary is the case, only we should begin with the milder procedures and gradually pass to the more powerful ones. With small children we should use douches, made gradually cooler and cooler, in the tepid bath. At a later period—and this applies also to adult age—cool washing of the entire body should be practised every morning, and this can still later be superseded by cold sponging, the cold douche, and the like. The chief use of these invigorating measures lies, therefore, so to speak, only in strengthening the cutaneous surface. Inasmuch, however, as chilling of the surface of the body plays an important part in the etiology of respiratory diseases, and especially in catarrh of the chest, a greater power of resistance to sudden

cooling, atmospheric influences, and the like, is secured by greater invigoration of the skin.

That improvement of the nutrition comprises the second important indication in feeble, scrofulous, rachitic, and similar constitutions, hardly requires mention. Experience shows sufficiently that with the improved nutrition of the individual, the power of resistance to external injurious influences increases also.

Like delicate children, so must the aged also be carefully protected from taking cold, from sudden change of temperature, and from the injurious influences of the weather, on account of the increased disposition to bronchial diseases in advanced life. The diminished tone of all the tissues in advanced life renders it possible for the same influences to which the body was subjected without injury in the prime of life, to easily produce disturbances at that advanced age ; disturbances which, from the same cause, are attended with much greater danger.

On the other hand, it is not to be denied that there is a class of individuals who, despite all precautionary measures, always become affected with catarrhs after the slighest exposure and at every sudden change of weather. For such persons, with excessive liability to catarrhs, the choice of a tolerably mild residence of equable temperature often affords the only certain prophylactic.

The same applies to the so-called idiosyncratic catarrhs. We recall here only hay-asthma, asthma idiosyncraticum. Here, often, nothing suffices but to leave the locality in which the disease has been acquired ; and experience shows that in many such cases simple change of locality suffices to cause the immediate disappearance of the malady ; while all other therapeutic measures remain unsuccessful.

In this sense residence in a southern, mild, uniform climate during the inclement seasons cannot be sufficiently recommended to people who suffer from bronchial catarrh.

We cannot enter more closely into further prophylactic measures, belonging more to the domain of general sanitary science. It is only too well known how much is wanting in this direction in daily life. We recall here only the importance of a constantly equable, but not too elevated, temperature of the chamber during the

winter season. How frequently, however, we see the grossest disregard of this simple hygienic rule! And truly it need be no wonder that a person who, after remaining for hours in an overheated room, suddenly exposes himself to the cold, moist air, contracts a catarrh; or that, when he exposes himself anew to such sudden changes of temperature again and again, he is unable to get rid of it. In the section on etiology we have already endeavored to explain the process of taking cold when the body is heated, on the sudden transition from an overwarm room to a very cool atmosphere; and the reader is referred to what has there been said in this connection.

Concerning the regulation of the temperature of the apartment in cases of acute or chronic bronchitis, it may be taken as a rule that the temperature of the sick-chamber should never be higher than 14° R. (63½° F.). Ordinarily a much lower temperature than this is not to be recommended; but under circumstances, however, in which pure air is not otherwise attainable than at the cost of some cold at the same time, as is not rarely the case in the confined apartments of the poorer classes, pure air, though it be cool, is to be preferred to that which is warmer but tainted.

The degree of moisture of the air is likewise one of the most frequently neglected points. Large vessels of water should always be kept in the chambers of bronchitic patients to maintain sufficient moisture of the air. The same end may be obtained by the use of atomizers.

The prophylactic measures relating to clothing, residence, heating, and the like, to be taken by those who are liable to catarrhs, need no further mention here. With reference to clothing, it may be remarked briefly that the constant use of flannel next to the skin cannot be sufficiently recommended to such persons.

Treatment.

In discussing the special treatment of bronchitic affections we have to discriminate, in the first place, between such general measures as aim at warding off external pernicious influences, or removing remote causes of disease existing in the individuals themselves, and such measures as are directed against the disease itself. The first two coincide with the causal indication. They

are based upon well-known principles, and need be but briefly adverted to here.

The fulfilment of these two indications, to ward off external pernicious influences, and to remove the individual causes predisposing to disease, is hardly possible in many cases. That where these two indications can be met the first and most important duty is to meet them, requires no demonstration. External sources of injury which irritate the bronchial mucous membrane, and which keep up bronchial irritation already existing, must of course be removed as far as is practicable. This is requisite not only at times when such catarrhal inflammations exist, but also at times when the health is sound. In many cases this indication cannot be fulfilled. In our remarks on etiology we have already mentioned a considerable series of occupations which exercise a direct irritation upon the bronchial mucous membrane. Many thus engaged, however, are not in a position to give up their employments, and resort to others which do not expose to similar danger. Where this first indication can be satisfied, the removal of these external sources of injury must of course be regarded as the first step to be taken.

This indication is also fulfilled if bronchitic patients are cautioned against exposing themselves to atmospheric changes during inclement seasons ; or if such patients, especially in cases of acute catarrh, are forbidden to leave their apartments, in which an equable temperature should always be maintained. The same regimen is strongly to be recommended not only in acute catarrhs, but in chronic catarrhs also. In primary catarrhs of not too long standing such a treatment, by which the patient is kept for weeks together in an equably warm and pure air, often suffices to remove the malady entirely.

As justly remarked by Niemeyer and Seitz, who highly recommend such a practice, its value is evinced by the experience of patients with chronic bronchial catarrh who, after having been confined to their rooms for a long time on account of other intercurrent maladies, express the opinion that the disease through which they have passed has exercised a critical influence upon their chronic complaint, so that they cough less than formerly and feel freer in the chest.

Where it is not practicable to avoid these external sources of injury, it is very difficult to institute really useful treatment. Where chronic bronchial catarrh occurs in consequence of a raw climate, it is advisable to send the patient to a milder climate during the inclement season. For persons who suffer from bronchial catarrh every winter, nothing can be recommended more urgently than resort to a milder climate for several winters. Many localities are suitable for this purpose, and in general those are to be recommended which have been found suitable as winter residences for consumptives.

As such winter resorts Nice, Mentone, Hyères, Venice, Pisa, Pau, Ajaccio, and Cannes are especially to be recommended, and we may add Palermo, Algiers, Cairo, Madeira, Catania, Davos, and so on. A sojourn on the Lake of Geneva, or somewhere about Meran, is advisable during the autumn, but these places are not suitable for the winter itself. Concerning summer resorts and the use of mineral springs, we shall speak hereafter, when describing measures directed against the diseases themselves.

We have designated as a further indication, and the one next in importance, the removal of the injurious influences existing in the individual himself which excite and keep up the bronchial catarrh. Thus, for example, those forms of tracheitis and bronchitis which occur under the influence of the syphilitic dyscrasia require an antisyphilitic treatment. The same holds good for scrofulosis and for rachitis, which, as is well known, engender a certain disposition to catarrhal inflammations generally, and to bronchial catarrh especially. In children with such a diathesis, a treatment directed against the diseased process itself, that is, the bronchitis, does not suffice. It is here essential first to attack the existing dyscrasia, and thus to remove the greater proneness to catarrhal affections, which, while being also a proximate or remote cause of origin, acts continuously as an obstacle to recovery. While in these cases all the expectorants and other remedies directed against the bronchitis fail as long as the existing dyscrasia is not eradicated, it often happens that these catarrhs are promptly cured when the children are better nourished and subjected to an anti-scrofulous and anti-rachitic treatment. In many cases, as a matter of course, it is not possible to satisfy the causal indication sufficiently. This is espe-

cially the case in secondary bronchitis resulting from valvular disease of the left heart.

The same principle holds good with other injurious causes which excite a collateral fluxion to the lungs. The more we are able to remove the fundamental cause or to ameliorate it, the more likely is the secondary bronchial catarrh to diminish in intensity, or even to disappear entirely.

This plan of treatment succeeds especially in people of middle age, who take but little exercise, lead a luxurious and more sedentary life and consequently have a sluggish circulation. Such patients often suffer at the same time with hæmorrhoids, gastric disturbances, frequent congestion of the head, and the like. Here a treatment directed solely against the bronchial catarrh hardly meets with any success worth mentioning. The mode of life must be regulated first, the disordered circulation excited, and the digestion improved.

Such persons, distinguished by marked corpulence, do much better under the use of saline-alkaline spring waters, than under an expectorant treatment. Patients of this kind are sent to Kissingen, Homburg, Marienbad, and the like, and are soon cured without the use of any expectorant or local respiratory treatment.

While the methods of treatment thus far mentioned have as their object only the proximate or remote causes of the disease, there is a large class of cases in which these methods do not suffice because they act only upon external or internal causes, and cases also in which these indications cannot be satisfied, as, for example, in catarrhs occasioned by certain avocations. With the promotion of favorable external or internal conditions, the conditions for recovery become more favorable, but the cure of a disease which has once become established is by no means always obtained. In all these cases—and they form by far the greater number—a special treatment directed against the disease itself is requisite. The remedies to be employed will vary according to the different forms and stages of the catarrh, the hyperæmia and swelling of the mucous membrane, the consistence of the secretion and its amount, and so forth. Unfortunately we must premise the remark that many of these indica-

tions are hardly to be satisfied by means of the remedies under
our control. Thus we have hardly any certain means to remove
hyperæmia and swelling of the mucous membrane; hardly any
that will overcome the thickening and induration of the mucous
membrane which occurs especially in chronic catarrhs. Often
we are compelled to limit ourselves to removing, or even only
ameliorating, the annoying symptoms, such as to relieve the
cough, to facilitate the expectoration of the bronchial secretion
and the like.

It will be judicious, before turning to the treatment of the in-
dividual forms of bronchitis, to treat briefly in general of the
more important remedies and methods which are directed against
the disease itself or against its most important symptoms.

To these belong first:

Local treatment in the form of *inhalations* of atomized
liquids, vapors, and gases. In diseases of the windpipe and
lungs, the inhalation of atomized liquids, and of vapors and
gases, form, as stated by Waldenburg[1] in his excellent manual
on respiratory therapeutics, the only general method of local
treatment. Experiments with other methods, such as injections
by the aid of catheterization of the trachea (Green), and insuffla-
tion, that is to say, inhalation of solid medicaments in the pul-
verized form, have likewise been made, it is true, but they have
as yet met with little encouragement; and justly so, because,
on the one hand, injection by means of catheterization of the
trachea can only be accomplished by very experienced hands,
and acts very powerfully; while, on the other hand, both by
injection and by insufflation, the locality to which the medica-
ments are applied cannot be determined accurately enough to
permit one to be certain that the diseased parts chiefly, and not
rather the sound parts alone, are brought into contact with
them (Waldenburg).

Treatment by inhalation finds employment in both acute and
chronic bronchial catarrh; and although it is not to be denied
that the value of this method in the affections under consider-
ation was much over-estimated at the beginning, it is not to be

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[1] Die locale Behandlung der Krankheiten der Athmungsorgane, 1872, p. 454.

disputed, on the other hand, that it has effected many good results. Waldenburg warmly recommends this method of treatment in recent bronchial catarrhs especially, and considers it desirable that it should hereafter be generally pursued at once in acute catarrhs; he thinks that catarrhs would then be less frequently neglected and allowed to become chronic. Although this latter opinion may perhaps appear too sanguine, yet the good results of this method in many cases is not to be denied. At the same time it should not be forgotten that many acute catarrhs often recover spontaneously under a suitable dietetic regimen, and that other methods also are competent, in like manner, to cure acute catarrhs in a short time.

In the same manner this method is also to be recommended, under proper circumstances, in the treatment of chronic catarrhs; partly against the chronic catarrh itself, and partly for the relief of individual symptoms. We will return to the special indications for this treatment, and the principal remedies to be employed in its use, in discussing the measures applicable to the separate forms of the disease. In acute catarrhs, and in chronic catarrhs with but little secretion and difficult expectoration, emollients and resolvents chiefly are chosen, and sometimes narcotics also. In chronic catarrhs, on the other hand, with copious secretion, astringents, balsams and resins, and, in certain conditions, carbolic acid, are the chief remedies employed.

The second class is formed of the special *expectorants*, to which the *nauseants* and *emetics* may be added. Frequently as expectorants are employed in practice, their value, on the whole, is to be considered as but slight. In their administration two objects are kept in view: the one merely to expel the masses of secretion adherent in the bronchi, and the other to combine with this the transformation of the tenacious secretion, poor in cells, into a loose secretion rich in cells. Whether this latter object can be accomplished in this manner must remain uncertain.

Above all other remedies belonging to this class of expectorants, in the wider sense of the word, to which is attributed also an anti-catarrhal action—that is, one which will make the secretion richer in cells, and thereby increase the facility of

expulsion of the product — we must place the *antimonials*, Kermes mineral, golden sulphuret of antimony, tartar emetic, and muriate of ammonia especially. Sal-ammoniac, particularly, is one of the remedies most frequently employed and most highly valued. It is employed chiefly in acute catarrhs during the period of defervescence ; when the cough is still dry, the secretion still scanty, and the tenacious mucus difficult to detach. Although its employment is sometimes justified in chronic catarrh, in the treatment of which its improper use is only too frequent, it is so only in cases in which the secretion is temporarily inclined to be stagnant, the expectoration becoming more tenacious and more difficult to detach. But even in the cases mentioned, it is not so valuable and indispensable a remedy as would be supposed from the frequency with which it is daily prescribed.

With these milder expectorants, to which a certain antiphlogistic action is likewise attributed, calomel also is classed, and has received an immoderate and unjustifiable employment, especially in infantile practice.

Apomorphine has been recently recommended as a good expectorant.[1] It is employed in doses of from one-sixth to one-half of a grain. The results of its action thus far reported are very favorable, the tenacious mucus always becoming more easily detached, the sputa more copious, and expectoration much easier. My own experience is also in favor of the expectorant qualities of this remedy ; though I must state that the number of cases in which I have thus far employed apomorphine as an expectorant is comparatively small.

Of the stronger expectorants, whose use is indicated in cases in which the patient can with difficulty and only incompletely cough up the abundant secretion, senega, benzoic acid, and ammoniacal solutions are the principal; to which may be added camphor and the like.

To these may be added the actual *emetics*, which are especially indicated in the suffocative forms of tracheitis, in which numerous bronchial branches are more or less occluded by mucus. They also come into use very properly in cases in which the tone of the bronchial muscles is so deteriorated that

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[1] Centralblatt f. d. med. Wiss., 1874, No. 32.

the secretion can no longer be expelled from the bronchi ; cases
which are often designated in common parlance as "paralysis of
the lungs." In these cases an emetic is the best expectorant,
provided the strength of the patient is still sufficient to justify
its use. Tartar emetic and ipecacuanha are most frequently
employed in these cases ; and the latter, used in smaller doses, is
likewise frequently employed as a milder expectorant. Muriate
of apomorphia is a much more safe, trustworthy, and prompt
remedy, and, as I first proved by numerous experiments,[1] is best
administered subcutaneously, in doses of from one-thirteenth
to one-sixth of a grain. Apart from its certain and unfailing
action, an important superiority of apomorphine over all other
emetics yet employed exists in the promptness of its action. In
from four to six minutes after its introduction the desired result
is produced, and is attended with but very slight and temporary
unpleasant effects ; and, furthermore, in special contrast to
other emetics, it does not exert any paralytic effect upon the
heart. It is therefore specially applicable to those cases in
which the danger of "paralysis of the lungs" is imminent, and
in which it is necessary to secure readmission of the air as
promptly as possible to the bronchi rendered impervious by
accumulated secretions, and thus to the alveoli.

Derivatives and *revulsives* are to be mentioned as a third
method of treatment, although they play but a subordinate part
in the management of acute and chronic diseases of the trachea
and bronchi, and are able to fulfil only certain special indica-
tions. These derivatives, by means of which it is sought to
remove or diminish the disturbance in the pulmonary circula-
tion, are partly such as act upon the skin, and partly such as act
upon the intestinal canal ; much less frequently, or hardly ever,
such as act upon the kidneys. The external integument is
selected most frequently for this purpose.

The *diaphoretic* method of treatment deserves to be employed
in those cases, especially, in which the bronchitis is recent, and
associated with but little or no febrile movement. Whether the
catarrh can be actually aborted by this method must remain

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[1] *Riegel* and *Böhm*, Deutsches Archiv f. klin. Med., Bd. IX.

undecided ; but it is certain, however, that cases of acute bron-
chitis often undergo rapid and marked improvement under this
treatment. So far as the method is concerned, it is, in general,
a matter of indifference by what means copious perspiration is
produced, whether by the administration of the ordinary diapho-
retics, or by means of vapor baths, hot baths, and the like.

The value of the leaves of jaborandi,[1] recently praised as an unusually energetic
diaphoretic, must be determined by further observation. My own limited experi-
ence with this remedy is strongly confirmative of its diaphoretic action.

In severe forms of bronchitis, associated with intense fever, on
the other hand, and in chronic bronchitic affections also, the dia-
phoretic method is no longer indicated.

Mustard plasters, vesicants, dry cups, and *irritating lini-
ments* are frequently used in the treatment of bronchial affec-
tions. The effects produced by them are only temporary. It is
especially in cases in which there is considerable swelling of the
mucous membrane, and in which the secretion stagnates so as to
cause considerable dyspnœa, that severe irritation of the skin
will produce momentary relief. The longer-continued employ-
ment of such cutaneous irritants is in no wise to be recom-
mended.

Purgatives are, on the whole, seldom resorted to to produce
revulsion from the lungs, or rather from the bronchial mucous
membrane. At any rate this method is confined to certain cases,
and principally to that form of bronchitis which occurs in ple-
thoric subjects who lead a luxurious and sedentary life and take
but little exercise.

The above remarks are still more applicable to the use of
diuretics. Of these remedies only such are employed as have
at the same time a certain effect upon the bronchial secretion,
as turpentine, for example.

As to *narcotics*, they are never employed in combating the
bronchitis itself, but only with the object of alleviating or reliev-
ing certain symptoms. Their use is especially indicated in bron-
chitic affections in which there is such severe irritation of the
bronchial mucous membrane that the patient is almost continu-

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[1] Bull. de thér., 1874, LXXXVI., 6, 282–283; Union méd., 1874, No. 45 ; Gaz. hebd.,
1874, No. 15.

ously harassed by his cough. These severe paroxysms of cough-
ing always irritate the bronchial mucous membrane afresh; and
with the subsidence or alleviation of the irritative cough these
new and constantly recurring sources of irritation are removed,
and thus a condition more favorable to recovery is produced.
In such cases, especially in those forms of catarrh associated
with great swelling and little secretion, but with severe cough,
narcotics are employed; and they are better adapted to loosen
the cough in these cases than any expectorant.

This form of catarrh is associated in many instances with a
spasmodic contraction of the bronchial muscles which tends to
increase the dyspnœa still more, even to the production of
asthmatic paroxysms. These bronchial asthmatic paroxysms
likewise indicate the administration of narcotics, as we shall see
hereafter in describing bronchial asthma. The use of nauseants
is urgently recommended by many in such cases, as is also that
of the iodide of potassium by Seitz. This latter remedy, as is
well known, forms the most important ingredient of Aubrée's
house remedy, so highly extolled in asthma. Gazeol [1] has re-
cently been recommended repeatedly in bronchial catarrh on
account of its influence in diminishing the irritable cough. The
special narcotic remedy to be employed is, on the whole, indiffer-
ent, so far as there are no special grounds in individual cases
contraindicating the employment of one or another.

There is sometimes an additional indication, which is *to
diminish the excessive secretion of the bronchial mucous mem-
brane*. For this purpose *astringent* remedies especially are re-
commended, tannin, acetate of lead, rhatany, and the like. Apart
from their uncertain action there is an objection to their use in
their alterant effect upon other secretions also. The desired
effect can be much better secured by the employment of *balsamic*
and *resinous* remedies, such as the balsam of Peru, copaiba, the
compound mixture of iron, and oil of turpentine especially.
These remedies are now most frequently administered by inhala-

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[1] A preparation introduced by Burin-Dubuisson. The formula for it is as follows:
Ammonia (20° Beaumè), 1,000 parts; acetone, 10 parts; benzine, 10 parts; naphtha-
line, 1 part; pix liquida (fresh), 100 parts. Dissolve the naphthaline in the benzine,
then add the ammonia, and finally the other ingredients.—*L'Officine*, par Dorvault.

tion. *Carbolic acid* has recently been recommended for the same purpose, chiefly in cases of fetid condition of the bronchial secretion, and it has been employed with very good results.

Antipyretics and *antiphlogistics* play but a subordinate part in the treatment of acute and chronic bronchitis. In the majority of cases there is but slight increase of temperature, and the employment of energetic refrigerants is as a rule not required. In the majority of cases the moderate fever, that accompanies acute catarrh at first, subsides of itself in a few days under simple dietetic treatment. In cases, however, of severe febrile movement, the use of cold in the form of baths and ice wrappings is indicated. The latter are capable of reducing the temperature of the body to a considerable degree. In severe fever cold baths undoubtedly take the first place, even in the treatment of acute bronchitis. Their employment is highly recommended for children with capillary bronchitis and intense fever, but it is better in these cases to use baths that are not too cold, but rather of a temperature of from 77° to 86° F. During the bath cold affusions can be made so as to excite deep respirations. According to circumstances such a bath may be prolonged from fifteen to thirty minutes or more.

That *quinine* in large doses is sometimes indicated to control the fever, needs no further argument. Its employment is indicated on the same grounds on which it is employed to control fever in general.

Antiphlogistics, on the contrary, are but slightly applicable to the treatment of acute or chronic bronchitis. But little, too, is to be expected from cold employed for its antiphlogistic effect. General *venesection* is never required in bronchitis as such. Whenever employed it can serve at most to combat some single dangerous symptom. *In children, general venesection is, as a matter of course, absolutely contra-indicated at any time.* In general the indication for venesection has been placed in an excessive accumulation of blood in the lungs and in the right heart, as shown by intense cyanosis, severe and rapidly increasing dyspnœa, great dilatation of the jugular veins, and so on. Many authors still favor this idea, and venesection is accordingly urgently recommended in the suffocative form of acute

bronchitis. The employment of venesection is advised even in
chronic bronchitis, if suffocative symptoms are present in conse-
quence of hyperæmia of the lungs. In slighter cases dry cups or
leeches, and the like, are recommended.

It is thus seen that even by the adherents of venesection that practice is recom-
mended only for those cases in which a passive œdema is threatened, occasioned by
the momentary inability of the right heart to overcome obstacles in its circulatory
system. How far the desired object can be accomplished by venesection, Jürgen-
sen [1] has explained clearly and convincingly in his excellent work on the treatment
of croupous pneumonia. We can apply what is there stated to the question before
us. That blood-letting by diminishing the amount of blood, may momentarily
diminish the work that the heart has to do, is undoubted. This removes the danger
of the moment, and experience proves, in fact, that the dangerous symptoms may
be diminished for a short time by means of venesection. The obstruction to the
pulmonary circulation is momentarily removed or diminished by the venesection,
and the right ventricle so much unloaded that it becomes able to drive more blood
into the left one. This diminution, however, has this result : that now the heart and
the muscles of respiration have to work harder than before the blood-letting, in
order to convey the proper quantity of oxygen to the tissues of the body (Jürgensen).

Though, therefore, in cases in which there is such a dangerous obstruction of the
pulmonary circulation, and in which other remedies are not available, the abstrac-
tion of blood may appear to be justified in robust individuals, it must not be for-
gotten that this remedy conceals in itself a reproduction of the danger, and that
stimulants which do not involve a similar danger in themselves accomplish the
same end better and without subsequent injury.

In young children and in debilitated subjects bloodletting is absolutely contra-
indicated as a matter of course, even in such cases as those mentioned, and stimu-
lants which remove the danger much better, are greatly to be preferred. At most a
small local abstraction of blood by means of a few leeches, or the like, might be
practised in these cases, a method, however, by which no important result is reached
with any certainty.

There is seldom any indication for the employment of internal
antiphlogistic remedies, in addition to which the action of most
of them is very uncertain and doubtful. Other remedies indi-
cated in special cases, as for example, *stimulants*, *tonics*, and
the like, need no special mention. The indication for their use
in bronchitis is the general indication for that class of remedies,
and they are employed only for the relief of symptoms. We

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[1] Volkmann's Sammlung klinischer Vorträge, No. 45.

shall return to this subject in describing the special treatment of the individual forms of bronchitis.

It remains to mention briefly a method of treatment which is employed more extensively than ever at the present day. This is the treatment by *mineral spring waters*, the *milk*, *whey*, and *grape cures*, and to a less extent the use of the juices of certain herbs.

If we should form a judgment of their efficacy from the frequency with which mineral spring waters are employed at the present day, the best results should be anticipated. But this is by no means the case, although it is not to be denied, at the same time, that the use of many mineral waters is attended with decided success, at least in the treatment of chronic catarrhs. It would be an error, however, to attribute the entire success of this treatment to the mere use of these mineral waters. In many cases the removal from the customary injurious influences, residence in a pure, healthy, oxygenated atmosphere, and similar factors occasion a goodly part of the favorable result.

We refer the reader to the treatises and manuals on balneotherapeutics for the special indications for the use of the different mineral springs, and especially to the manual of Helfft,[1] and content ourselves with briefly mentioning the principal resorts.

The use of the springs at Ems, so rich in carbonic acid, is chiefly adapted to the more torpid class of patients with relaxed mucous membrane and abundant secretion, so long as there are no symptoms of large caseous pneumonic foci and the patients are not anæmic. For more marked anæmia, the alkaline springs of Koehel at Lake Kochel, in Upper Bavaria, are to be recommended. The use of the soda-lithia spring in Weilbach is especially suited for persons who have suffered from scrofulous affections in youth, and who are prone to contract catarrhal affections after changes in the weather; particularly when they are full-blooded and disposed to congestions of the lungs. So, likewise, the saline alkaline springs of Luhatscho-witz in Mähren are suitable to scrofulous constitutions.

In old chronic catarrhs, with dry cough and scanty expectoration, the springs of Weissenburg, in the Canton of Berne, may be successfully employed if the patients are still well nourished. In all chronic bronchial affections, where there exists a blennorrhœic stage, the following-named alkaline and muriated alkaline mineral springs may be employed with advantage: Gicshübel, Bilin, in Bohemia; Geilnau, in Nassau; Fachingen, Gleichenberg, in Steiermark; the Tonnissteiner Springs, in Brohlthal; the Springs of Borszèk, Elöpatak, Ronda, and those of Selters, Ober-selters, and Roisdorf.

Then, again, there are patients in a rather advanced period of life, who, with a general plethora, suffer from hæmorrhoids, and circulatory disturbances in the abdominal vessels; and in whom chronic catarrh of the bronchial mucous membrane may become developed. For these patients the saline-alkaline mineral springs

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[1] *Helfft-Thilenius*, Handbuch der Balneotherapeutics, 8th ed. Berlin, 1874.

are indicated, especially the Oberbrunnen, in Salzbrunn; the Waldquelle, in Marienbad, Lippspringe, etc.

Soden is suited for irritable, feeble persons, with a torpid, atonic condition of their abundantly secreting mucous membrane.

In pasty, phlegmatic individuals, who suffer at the same time with disturbances of digestion, the cold and warm sulphur baths at Weilbach, Wipfeld, Langenbrücken, Nenndorf, and the like, are to be recommended.

Catarrh is frequently developed in rheumatic subjects. If the patient is irritable and of feeble constitution, Ems is to be recommended; for plethoric cases the muriatic springs of Kissingen, Homburg, and even Wiesbaden, Baden-Baden, and the like are to be employed.

Milk and whey cures are frequently employed in chronic bronchial catarrhs, especially in delicate subjects. Among the places especially suited for the whey-cure, the following are to be mentioned: Ischl, where patients may likewise avail themselves of the salt spray and vapor-baths, as well as the simple salt-baths; Reichenhall and Kreuth, in both of which places the juices of herbs can likewise be used; Interlaken, Reinerz, Weissbad, etc. A direct influence upon the bronchitis is not to be expected from these cures; the use of mineral waters, especially the alkaline-muriatic springs, is often associated with them.

Finally, the grape-cure is sometimes employed in chronic catarrhs, more so recently than formerly. It is recommended for such bronchial catarrhs as are associated with great thickening of the mucous membrane, in which the tenacious secretion becomes clogged in the bronchi, thereby rendering expectoration difficult. Special success is not to be anticipated from this method in most cases. The resorts most worthy of recommendation are: Meran, Dürkheim, in the Rhenish Palatinate; Neustadt, on the Haardt; Gleisweiler, Bingen on the Rhine, Vevey, Montreux, Clarens, and Vernex, on Lake Geneva; and Aigle, Bex, and Sion, in the valley of the Rhone.

Finally, we have to mention the *pneumatic* cabinet, the employment of *condensed* and *rarefied* air, as a more esteemed recent mode of treatment. The results thus far obtained in chronic catarrhs by sojourn in pneumatic cabinets, speak strongly in favor of this method; but it is at the same time to be regretted that the opportunity for employing pneumatic cabinets is quite limited. It was therefore a considerable step in advance when, a few years ago, Hauke,[1] of Vienna, first constructed a small portable apparatus, by means of which both condensed and rarefied air can be employed for respiration.

The advantage of these portable apparatuses consists not only in this feature of transportability, which places them within easier reach of a large number of patients, but also in the circumstance that both the compressed and the rarefied air may be used separately, during either expiration or inspiration. They differ, how-

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[1] Ein Apparat zur künstlichen Respiration und dessen Anwendung zu Heilzwecken, with 2 wood-cuts. Wien, 1870.

ever, from the pneumatic cabinets in this, that the entire body is subjected to the influence of compressed or rarefied air in the cabinets, while in the portable apparatuses only the inner surface of the lungs is subjected to this influence.

After the impetus was once given by Hauke to the manufacture of such portable apparatuses, improvements were soon suggested, and new and more complete apparatuses were constructed for the same purpose, especially by Waldenburg, Berkart, Störck, Cube, Biedert, and others. Without entering into any special criticism of all these transportable apparatuses, I will simply remark, as the result of numerous personal observations, that, according to my experience, Waldenburg's apparatus [1] amply fulfils all the requirements.

With regard to the employment of condensed or rarefied air in chronic catarrhs, I must recall the fact, shown by my own stethographic as well by Waldenburg's pneumatometric investigations, that chronic bronchial catarrh, like emphysema, is chiefly associated with an impediment to expiration. The indication is therefore clear, to seek such remedies as first of all assist expiration; and with this object Gerhardt [2] has recommended and introduced the practice of producing mechanical compression of the thorax during expiration, in cases of emphysema and chronic catarrh. Gerhardt has likewise observed favorable results from this treatment in febrile cases of bronchitis and dilatation of the bronchi with copious secretion,[3] and considers it in these cases as the most powerful expectorant; the fever was subdued or reduced by it, and the expectoration greatly facilitated.

The favorable results obtained by Waldenburg from the use of condensed and rarefied air in emphysema and chronic catarrh, have been recently substantiated in every point by the recorded experience of Sommerbrodt [4] and Hänisch.[5] Not only has the expiration into rarefied air been proven efficacious, but also the inspiration of compressed air. Sommerbrodt was especially attracted to the employment of the inspiration of condensed air, because, according to Waldenburg's investigations, the inhalation of condensed air increases the pressure and afflux of blood in the aortic system, impedes the flow of the blood from the veins into the right heart, and thereby diminishes the amount of blood in the lungs. While Sommerbrodt repeatedly saw every attempt fail to recall the lost expiratory power in old emphysema, yet, on the other hand, in more than fifty cases of recent emphysema (or rather of distended lungs), and especially of bronchial catarrhs of the most different and even very long periods of duration, he never saw the curative effects fail entirely, and in most cases they were complete. Similar favorable results have been observed by Hänisch, and demonstrated objectively, during the treatment and after it, by

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[1] Berliner klinische Wochenschrift, 1873, Nos. 39, 40, 46, and 47.

[2] Berliner klin. Wochenschrift, 1873, No. 3.

[3] Verhandlungen der phys. med. Gesellsch. zu Würzburg vom 21. Feb., 1874, and Deutsches Archiv f. klinische Medicin, XV. Bd.

[4] Berliner klinische Wochenschrift, 1874, Nos. 15, 31.

[5] Deutsche Archiv für klinische Medicin, XV. Bd.

graphic representations of the respiration with my simple stethograph. Störck [1] expresses himself in favor of this mechanical treatment, on the basis of numerous personal observations.

Our own numerous personal observations only corroborate the successful results of this method of treatment in chronic bronchial catarrh, and we welcome in the portable pneumatic apparatus a remedial agent that deserves a more general acceptance than it has yet received.

We now turn to the description of the treatment of the individual forms of bronchitis, and we can be the briefer that the most important remedies coming under consideration, and the indications for their employment, have been already discussed.

Treatment of Acute Bronchitis.

Acute, genuine tracheo-bronchitis is almost always a benign disease in adults, in whom recovery usually ensues spontaneously within a short time.   Very frequently no special therapeutic measures are required, beyond warding off all external injurious influences.   The patient should be subjected to a proper dietetic regimen, and should always be kept in an equable temperature night and day, the apartment being well ventilated ; and for the first few days, especially if there is any fever, he should keep his bed.   At the commencement, when the swelling of the mucous membrane is at all considerable, and the secretion scanty, some relief may be obtained by breathing warm vapor. The treatment of recent bronchial catarrh by inhalation is highly recommended by Waldenburg.[2]   Emollients and resolvents chiefly, and sometimes narcotics, are to be selected for this purpose.

Diaphoretic drinks are a favorite remedy in acute catarrh, and hot spirituous drinks are also frequently employed in such catarrhs.   An actual abortion of the complaint, as is often believed to be produced by these methods, is not to be expected.

Rubbing the chest with warm fat or oil, and the application of a poultice of the same materials around the neck, are favorite

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[1] Mittheilungen über Asthma bronchiale und die mechanische Lungenbehandlung. Stuttgart, 1875.

[2] Die locale Behandlung der Krankheiten der Athmungsorgane, 1872, p. 454.

popular remedies. When the cough is severe, narcotics are indicated.

Of actual drugs, sal ammoniac is the one most frequently employed; then come small doses of ipecacuanha, antimony, and the like. Special results are hardly to be expected from these remedies. The above-mentioned dietetic regimen is much more important, and is often sufficient by itself for recovery in mild cases.

It is otherwise in severe cases. The treatment must vary here, according to the vigor of the patient and his period of life, and according as the severity of the affection in individual instances has been occasioned by this or that special influence. Thus, in cases of severe acute bronchitis, in which the fever becomes tolerably high, this symptom should be selected as the point to be attacked by therapeutic measures. It requires no argument to prove that cold takes its place here in the foremost rank. The indication for its use, especially in the form of cold baths, is just as strong in febrile bronchitis as in pneumonia. Quinine and other like anti-febrile remedies are to be employed as circumstances may call for them.

In other cases the dyspnœa preponderates over the other manifestations, in consequence of great swelling of the mucous membrane and extension of the inflammation into the minuter bronchial ramifications. Even here the application of cold will be found useful under certain circumstances, particularly in children, in whom it will excite deeper respiration. The above-mentioned inhalations of warm vapor of water, of alkaline carbonates, and the like, may be of important service, at least in adults, by alleviating the cough, and thus removing a source of continuous irritation. Venesection is rarely indicated in any case of acute bronchitis. Local abstraction of blood may produce momentary relief; but it is by no means competent to exercise a permanent influence upon the course of the disease. The same remark holds good with reference to the various cutaneous irritants, such as mustard-plasters and the like. In debilitated subjects every depressing measure is contraindicated as a matter of course, especially the abstraction of blood. Here stimulant remedies are indicated, and in large doses. Depressing measures

in general cannot be too much warned against in acute bronchitis. The course of such cases of bronchitis is often rendered more severe from the too diligent employment of such depressing measures.

Expectorants are usually of little or no use at this stage. Emetics are applicable only when previous physical examination has demonstrated the presence of great masses of mucus within the bronchial tubes.

When the cough is too severe, narcotics are to be employed : opium, morphia, Dover's powder, and the like. In children and aged subjects it is better not to give any direct remedy for the cough.

At a later stage, in which the crude consistence of the sputa has already disappeared, and the secretion of the bronchial mucous membrane has become more copious, expectorants may be employed, and especially senega, ammoniacal solutions, and the like. So also inhalations, especially of carbonate of soda, lime-water, tannin, and the like, prove of the greatest service.

In aged subjects all debilitating methods are contraindicated as a matter of course. The fever is rarely high, and therefore the use of powerful febrifuges—cold especially—is almost always unnecessary. On the contrary, a corroborant procedure is to be adopted in order to counteract the threatened exhaustion. Careful examination of the pulse is of the greatest importance in these cases, as it is in all severe cases of bronchitis, as well as in pneumonia ; for the greatest danger is to be dreaded from the great disturbance of the circulation and the unequal and immoderate action of the heart. Besides, there is the danger of insufficiency of the heart. Special attention, therefore, is to be given to the nutrition and strength of such patients. Alcoholic drinks are to be administered from the commencement of the affection, even when there is high fever, the more so that, as shown by numerous experiments of Binz,[1] myself,[2] and others,

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[1] Uber die antipyretische Wirkung von Chinin und Alkohol, Virchow's Archiv, Bd. 51, p. 6.

[2] *Riegel*, Uber den Einfluss des Alkohols auf die Körperwärme, Deutsches Archiv für klinische Medicin, Bd. XII., p. 79.

the body-temperature is not increased thereby, but, on the contrary, is diminished.

Emetics, on account of their depressing after-effects, are to be limited, in aged subjects, to the most urgent cases, and to be avoided altogether when possible. Apomorphine is to be preferred in these cases, as its administration is associated with the slighest after-effects.

Powerful derivatives are to be avoided likewise, on account of their depressing influence. It is hardly necessary to add that care must be taken to secure regular evacuation of the bowels. Stimulant remedies, in a limited sense, are suitable in cases of threatened or already existing collapse, and must be employed as soon and in as concentrated a form as possible—chiefly strong old wine, champagne, musk, ether, benzoic acid, camphor, and the like; the latter deserves to be employed especially in the form of subcutaneous injections.

In children, great care should be exercised in the treatment of the severe forms of bronchitis, and more especially of capillary bronchitis. The employment of certain special remedies is not so requisite as the careful consideration of each individual case and the accurate appreciation of every element in it.

All external injurious influences should be removed with the greatest solicitude. The air should be kept fresh and pure, but not too dry; there should be a constantly equable temperature in the sick-room; suitable nourishment should be provided; the coverings of the bed should not be too warm, etc., etc. The treatment[1] by inhalations also deserves to be employed in the manner already mentioned, provided that the children are sufficiently tractable. The question of nourishment should receive special attention. Wine plays an important rôle here also as an

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[1] In view of the difficulties encountered in pursuing the treatment by inhalations with nurslings and young children, *Abelin* (Hygiea, Marts, p. 121, 1868) has introduced, in the Hospital for Children in Stockholm, the methodic employment of inhalations of warm vapor of water, in the form of what might be termed a permanent vapor bath; by this plan the atmosphere of the apartment is kept continuously saturated with vapor, the patients being confined in this atmosphere for days and weeks together until recovery has taken place. From the statistics reported by this author, it appears that the mortality among children with capillary bronchitis has diminished more than half since the introduction of this method.

invigorating remedy.   For small children Nestle's infant-food, which is by far the best substitute for the milk of the mother, has recently been justly recommended as a nutritious and invigorating remedy.

Care must be taken to secure frequent change of position, to prevent the accumulation of mucus in the lower lobes of the lungs or in other places, and thus to avoid hypostasis and its consequences.

Cold douches and ablutions are to be especially recommended for the purpose of exciting deeper respirations.

For the fever we employ cold wrappings, or even cold baths; small doses of quinine also, under suitable circumstances; and the like.   General abstractions of blood are always contraindicated in children.   Even from local bleedings no special benefit is to be expected, and, when resorted to, they should only be employed in the cases of very vigorous and well-nourished children.

Expectorants afford, on the whole, but little benefit.   If the object is to get rid of mucus that has accumulated in the bronchi, emetics may be used, either alone or in conjunction with the stronger expectorants.

Narcotics should be employed with the greatest circumspection, and only in case of severe irritative cough.   When manifestations of collapse are threatened, or are already present, stimulants are required.

Treatment of the Chronic Forms of Bronchitis.

Chronic bronchial catarrh, which occurs with greatest frequency after middle age, presents but few salient points of attack to treatment in general.   The same remedies and modes of treatment that have already been mentioned come into use here also.   We have already alluded sufficiently often to the fact that these remedies can produce but little effect upon the inflammatory process of the mucous membrane; and this is especially true of the so-called expectorants.   This impotence in therapeutics is evident in still greater measure in the treatment of chronic catarrh.

The causal treatment—that is to say, the removal of all those sources of injury which have occasioned the catarrh, or which favor its continuance—is here of the greatest importance. Inasmuch, however, as this first and most important indication cannot be satisfied in many instances, the successful treatment of these cases is impeded by difficulties in part insurmountable. This is true, for example, of those catarrhs which have become developed in consequence of valvular affections of the heart. In many catarrhs likewise which have occurred as the result of certain avocations associated with the development of dust, there is no hope of successful treatment if the source of injury is not removable. It needs no argument to prove that wherever these causal indications can be followed, their fulfilment is the first object in treatment.

In reference to the special treatment of chronic bronchitis in a more restricted sense, the therapeutic principles already mentioned apply here in general also. These vary so greatly according to the special variety of the disease, the duration and severity of individual symptoms, the age, corporeal vigor, and other conditions of the affected individual, that we shall be justified in giving a brief description of the special indications.

We begin, first, with the so-called dry variety, the *catarrhe sec* of Laënnec, for the treatment of which Laënnec has already laid down the essential principles. We must recollect that the minuter bronchi are here the predominant seat of the catarrhal affection, and that a further characteristic exists in the scanty, but often extremely difficult expectoration, and in the severe paroxysms of cough. We have already made reference to its intimate relationship to emphysema. Here the object of treatment is to remove the hyperæmia and swelling of the bronchial mucous membrane, and especially to detach and dilute the tenacious bronchial secretion.

For this purpose, alkalies are most deserving of trial, and they are frequently employed, especially at the present time, in the form of inhalations. In mild grades of the affection even the inhalation of warm vapor of water is competent to alleviate the severe paroxysms of cough and facilitate expectoration. The alkalies are also frequently employed in the form of mineral

waters ; the special selection of which should be made in accord-
ance with the rules already laid down.   The special expectorants
are of but slight service in this form of catarrh.

The employment of condensed and rarefied air is furthermore
to be mentioned as a means of medication that has recently
come into greater use.

While increased atmospheric pressure in the pneumatic cham-
ber has been employed in Germany as a remedial agent for more
than twenty years, it is only since the introduction of trans-
portable pneumatic apparatuses that any extensive employment
has been made of condensed or rarefied air.   The results, so far,
are much in favor of the efficiency of this agent in the forms
of disease under consideration.   Great progress has recently
been made in the knowledge of the physiological principles
upon which its employment depends, chiefly by the investiga-
tions of von Liebig,[1] Quincke and Pfeiffer,[2] von Vivenot,[3]
Waldenburg,[4] and others.

As far as present experience indicates, the alternate employ-
ment of condensed and rarefied air is most to be recommended
in the drier varieties of chronic catarrh.   This does not require
an apparatus of such a kind that both kinds of air can be made
simultaneous use of in the individual phases of respiration ; the
arrangement provided in Waldenburg's and other similar appa-
ratuses suffices completely for the purpose.   It is best to let
such patients make expiration into rarefied air, while inspiration
is made with ordinary air only, and it is frequently advisable to
follow this procedure by a series of inspirations of compressed
air, expiration being made into the ordinary atmosphere.

Numerous further observations are requisite, as a matter of
course, in order to appreciate the indications and contraindica-
tions of this method of treatment more minutely than is at
present possible.   Still the experience thus far gained with the

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[1] Deutsches Archiv f. klin. Med., Bd. X., Heft 3.—Deutsche Klinik, 1872, No. 21.—
Mittheilungen und Auszüge aus dem ärztl. Intell.-Blatt. 1 Ser., No. 4, 1874.

[2] Reichert's und Dubois Reymond's Archiv, 1871, Heft 1.

[3] Zur Kenntniss der physiol. Wirkungen und therap. Anwendung der verdichteten
Luft, von *R. von Vivenot*, jun.   Erlangen, 1868.

[4] Berliner klinische Wochenschrift, 1873.

method is already so much in its favor that we need not hesitate to believe that in the portable pneumatic apparatus we have an extremely valuable remedial agent for the treatment of the diseases under consideration.

The remaining remedies mentioned on previous pages are to be employed according to well-known indications. Thus, for example, emetics are to be employed, not when the swelling and hyperæmia predominate, but when an abundant secretion closes numerous bronchial tubes and thus occasions dyspnœa.

Cutaneous irritants are in general merely of temporary benefit. Under certain circumstances they may be found of service to diminish manifestations of dyspnœa.

Dry catarrhal bronchitis, as already mentioned, is not infrequently observed in children also ; and it is always a very serious disease, frequently terminating fatally. As regards the treatment of the affection, the frequent inhalation of warm vapor of water, of alkaline remedies, of solutions of carbonate of soda, lime-water, tannin, and the like, play the predominant rôle.

Emetics, in most instances, are of no special benefit. On the contrary, the indication is not infrequently for stimulants, when severe dyspnœa and evidences of collapse are present. Expectorants are of little use. Narcotics, opiates especially, are to be administered for the purpose of relieving the occasional severe paroxysms of cough.

Winter-cough should be mentioned as another and a mild form of chronic bronchitis, associated with but moderate expectoration. As the designation "winter-cough" indicates, the appearance of this form of the affection is coincident with the onset of the inclement season. This suggests in itself the proper treatment, to wit, certain prophylactic sanitary regulations. It is especially advisable for persons suffering with this form of bronchitis to resort to a mild southern climate during the inclement portion of the year, so as to avoid the injurious influences which experience has shown to be the cause of the malady. The majority of patients suffering with this form of disease are not, however, in a position to avail themselves of some southern climatic health-resort. So far, then, as circumstances permit, care should be taken that the patient remain in an apartment

constantly maintained at an equable temperature; that he should
be warmly clad, and that he should avoid every external source
of injury, every risk of taking cold, and the like. Special treat-
ment is to be directed in accordance with the principles applica-
ble to bronchitis in general. The employment, also, of com-
pressed and rarefied air in the manner already mentioned is to be
recommended in these catarrhs.

In those cases in which the bronchitis is associated with cer-
tain dyscrasiæ, such as scrofulosis, syphilis, and the like, the
chief attention must, as a matter of course, be directed to these
fundamental affections. Especially should it not be forgotten
that, under the influence of syphilis, inflammatiory conditions,
although less frequent than in the larynx, are sometimes estab-
lished in the trachea and the bronchi, and that they may even
progress to ulceration, and finally to the production of constrict-
ing cicatrices. The clinical picture of this condition, however,
does not vary from that of simple inflammatory conditions, so
long as it has not progressed to stenosis.

We have already learned to regard *fetid* bronchitis as an
additional form of chronic bronchitis. Here, it is self-evident
that the first indication in the treatment is to suppress the putrid
decomposition of the bronchial secretion. Inasmuch as the pro-
longed retention of the secretion within the bronchial tubes
favors its putrid decomposition, the object of treatment, in cases
in which the secretion stagnates for a long time, is to prevent
this stagnation. This indication often can only be fulfilled very
incompletely. The ultimate cause of the stagnation is often to
be found in conditions which are not removable, such as bron-
chiectasiæ, paralysis of the bronchial muscles, diminished sensi-
tiveness of the mucous membrane, and the like. To prevent the
long retention of the secretion within the bronchial tubes, by the
administration of emetics, is a method which in any instance can
only be temporarily employed, and in no instance can be re-
peated with sufficient frequency. Powerful expectorants are
likewise only partially competent to satisfy this indication.

Therapeutic efforts, therefore, have long been directed to-
wards preventing the decomposition of the bronchial contents.
Inhalations of oil of turpentine were first recommended for this

purpose by Skoda, and they have long been accepted as the exclusive method of treating these affections. Other disinfectant substances recommended by various authors, such as chlorinated water, permanganate of potassa, and the like, have proved of little value. Inhalations of carbolic acid, in a solution of from two to four per cent., have been recently especially recommended by Leyden.[1] I can fully substantiate the exceedingly favorable results reported by Leyden. Leyden recommends masking the unpleasant odor or taste, in sensitive patients, by means of mint-water, and also the internal administration of the same remedy in a solution of from one quarter to one per cent., in tablespoonful doses. Leyden also speaks favorably of the use of alcohol in these cases, on account of its disinfectant properties.

Of internal remedies we have yet to mention quinine, inasmuch as, according to Binz, it not only acts antipyretically, but also disinfectantly upon putrid processes ; and further, acetate of lead, tannic acid, and the like, recommended by Traube.

Frequently, also, a corroborant treatment is required, with bitters and tonics, iron, strong diet, and the like.

To lessen the fetor the apartment should be kept well ventilated, and powdered charcoal, chlorinated lime, and the like should be placed in different parts of it. The remaining symptoms are to be treated according to well-established therapeutic principles.

We have already spoken of *broncho-blennorrhœa* and *serous bronchorrhœa* (the pituitous catarrh of Laënnec) as further subvarieties of bronchitis.

In the first variety, which is characterized by the discharge of copious quantities of muco-pus, treatment is directed to two principal objects : first, to prevent the formation of this purulent mucus ; and, second, to facilitate its expectoration. The first object is best fulfilled by the balsamic remedies, of which oil of turpentine has been the most extensively employed, most frequently by inhalation, less frequently by internal administration. Copaiba, balsam of Peru, and balsam of Tolu, myrrh,

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[1] Ueber Lungenbrand, Sammlung klinischer Vorträge, herausgegeben von R. Volkmann.

and ammoniac are also recommended for this purpose. Carbolic acid, in addition to its disinfectant properties, has also the property of restricting the secretion of pus. As further remedies of the same sort, though far less effective, acetate of lead, tannin, rhatany, and similar desiccating and astringent remedies may be recommended.

The second indication of treatment is to facilitate the expectoration of the secretion. As this is impossible without cough, and as, on the other hand, the activity of the auxiliary muscles in the act of coughing is an important condition for the expulsion of this secretion, the abatement of the disposition to cough by narcotic and sedative remedies is here contraindicated. On the contrary, it is essential to employ remedies which excite the efforts of coughing. When, therefore, the cough is in itself not sufficiently powerful to accomplish the expulsion of the secretion in the bronchi, the employment of such remedies is demanded as are calculated to effect this result. Under certain circumstances, therefore, even emetics are to be recommended to this end. In other cases powerful expectorants, as senega, ammoniacal solutions, benzoic acid, and the recently introduced muriate of apomorphia are applicable for the purpose.

Mechanical compression of the thorax during expiration is also to be recommended in these cases (Gerhardt).

It is scarcely necessary to add that ample nourishment must be provided to supply the waste occasioned by the copious bronchial secretion. The administration of alcoholic and corroborant remedies are frequently demanded in these cases.

We have mentioned bronchorrhœa, the pituitous catarrh of Laënnec, as the last variety of bronchitis. The characteristics of this variety consist in the abundance of the sputa, in the paucity of the cellular elements which they contain, in their serous consistency, and in the fact that they are expectorated after severe paroxysms of cough. This variety is usually developed out of other forms of chronic bronchial catarrh, and is very frequently associated with affections of the heart which lead to stasis in the bronchial veins, or with pulmonary emphysema, and the like. Inasmuch as the disturbed conditions of the circulation play an important rôle in the production of bronchor-

rhœa, the first indication in treatment is to regulate these con-
ditions. It is not practicable, however, in the majority of cases,
to satisfy this indication completely. Regular modes of living,
the removal of all external sources of injury, the avoidance of
every strong exertion, precautions against taking cold, care for
regular evacuation of the bowels, and the like are to be men-
tioned as tending to promote the object in view.

In addition to this, derivatives towards other organs are
to be employed, in the hope of exciting increased secretions
from them in order to relieve the bronchi. Derivatives to the
bowels and the kidneys are employed most frequently. The
benefit from this practice is usually but very slight or quite
temporary ; or else it fails completely.

In addition to these measures, astringent remedies may be
employed, in order to limit the bronchial secretion in a more
direct manner ; such are, for example, alum, tannin, lead, chlo-
ride of iron and the like. These remedies are employed most
frequently in the form of inhalations. The *pneumatic* treatment
is also to be recommended in these cases in the manner already
mentioned

Narcotics, in general, are but seldom to be used, for the same
reasons as those advanced in speaking of broncho-blennorrhœa.

Powerful expectorants, emetics, and excitants also, are em-
ployed in these cases, according to the same rules as have been
briefly sketched for their employment in broncho-blennorrhœa.

PSEUDO-MEMBRANOUS, CROUPOUS, OR FIBRINOUS BRONCHITIS ; BRONCHIAL CROUP ; BRONCHITIS WITH THE FORMATION OF FIBRINOUS CASTS.

Prefatory Remarks.

The subject before us, concerning which, on account of its general rarity, hardly an individual observer is in a position to acquire great personal experience, has already been worked up with great clearness by Biermer in Virchow's Manual.[1] Biermer has based his study upon clinical material, comprising fifty-eight cases, of which two occurred under his own observation. In addition to this, Biermer has in the most commendable manner gathered together a complete bibliography of the subject, old and recent. Lebert has recently presented an analogous study of the subject, based on a careful analysis of all the cases hitherto reported. Lebert has published, both in a separate essay (Deutsches Archiv f. klin. Med., Bd. VI.), and in his recent work entitled "Klinik der Brustkrankheiten," an accurate description of this form of disease, based upon the clinical material which he has found recorded in medical annals.

Biermer, in his work on the subject which forms the basis of our own study of the topic, includes under the name of bronchial croup only those cases in which the croupous process is limited to the bronchi, or has at least taken its starting-point in these tubes. On the other hand, those observations in which the croup extended from the larynx to the bronchi are not included, nor those in which casts have formed in the bronchi during the progress of a croupous pneumonia. But he does take into consideration the secondary bronchial croup which is sometimes observed as a result of chronic affections of the lungs, tuberculosis for example.

Lebert also excludes those cases in which the fibrinous bronchitis is a continuation of fibrinous laryngitis. On the other hand, he includes among his examples of fibrinous bronchitis, the cases in which casts have formed in the bronchi in the course of croupous pneumonia, and then distinguishes the following six categories:

1. Incomplete observations ; 2. Cases of acute fibrinous bronchitis without unmistakable signs of the condition during life; 3. Cases of acute bronchitis, with characteristic manifestations, such as, in particular, fibrinous expectoration; 4. Cases of acute pneumonia with extensive formation of membrane, without characteristic expectoration, and cases of acute pneumonia with expectoration of extensive fibrinous formations (smaller specimens are expectorated in almost every case of diffuse pneumonia) ; 5. Chronic essentially fibrinous bronchitis ; 6. Chronic symp-

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[1] Virchow's Handbuch der speciellen Pathologie und Therapie, 5. Bd. *Biermer*, Krankheiten der Bronchien und des Lungenparenchyms.

tomatic fibrinous bronchitis. In the following remarks we shall adopt Biermer's division, and describe in the first place only that form of croupous bronchitis which *commences primarily in the bronchi*. On the other hand, we shall exclude from consideration both that form in which croupous laryngitis has extended into the trachea and the bronchi, and also that form in which the croupous inflammation of the alveoli of the lungs has been secondarily transplanted upon the terminal ramifications of the bronchi.

Although the bibliography of this subject is to be found collected in the manuals of both Biermer and Lebert, and we have but few new observations to add, it appears desirable to premise the discussion of our theme by a brief survey of what has been thus far written upon it. In doing this we will only include those cases which belong to our subject, in accordance with the definition given above.

Galenus, De locis affectis, Lib. I., Cap. 1. (He relates that he has seen a pulmonary vessel expelled; apparently this is to be regarded as a bronchial-cast.)—*Marcellus Donatus*, De medica historia memorabile, Lib. VI. Mantua, 1586.—*Haller*, Bibliotheca anatomica, I., 263.—*Morgagni*, XXI., 20. edit. nona Lutetiæ, 1821, T. III., p. 35. (He speaks of a small venous tube expectorated.)—*N. Tulpius*, Observation. medic., Lib. II., Cap. XII., p. 115. Amstelodami, 1641. (Two cases with good representations of the expectoration, which are designated as *Sureuli venæ arteriosæ expectorati*).—*Th. Bartholinus*, Histor. anatom. r., Cent. III., hist. 17 and 98, 1657. (Two cases.)—*Moellenbroek*, Ephemer. natur. curios., Dec. 1, An. II., Obs. 91, 1671.—*Verzascha*, Obs. med. Cent. Basil, 1677, Obs. 25.—*Bonnetus*, Sepulchret, Lib. II., Sect. 6, and Lib. I., sect. 22. Genev., 1679.—D. B. Observ. singul., etc. Act. erudit., 1683, p. 281.—*Mack*, Ephem. Natur. cur. Dec., II., An. X., Observ. 102, 1691.—*Ruyschius*. Resp. ad Epist., probl. VI., Fig. 4, Museum anatom., p. 122. (Describes the expectorated masses as polyps.)—*Clarke*, Philos. Transact., Vol. XIX., 1697, p. 779. (First accurate description of a case of chronic fibrinous bronchitis.)—*Bussière*, Philos. Transact., Vol. XXII., 1700–1, p. 545. (A case observed in a boy five years of age, with autopsy.)—*Lémery*, Histoire de l'Académie des Sciences, 1704, p. 23.—*Samber*, Philos. Trans., 1727, p. 262. (Hæmoptysis and expulsion of an enormous polyp, having many ramifications. Illustrated.)—*Struve*, Acta Med. Phys. Nat. Cur., Vol. I., November, 1727, Obs. 96.—*Nicholls*, Phil. Trans., Vol. XXXVII., p. 123, 1731–32.—*Pasta*, Epistol. de Cord. polyp. n. 11, Bergam., 1737; Morgagni XXI., 20.—*Kaaw Boerhave*, Perspiratio sic dicta Hippocratica, etc. Lugd. Batav., 1738, p. 114. (Case of chronic fibrinous bronchitis.)—*Kellner*, Acta natur. Cur., Vol. V., 1740, p. 283, Obs. 14.—*De Haen*, Ratio medendi., T. II., c. VII., 1758. (Pleuritis with expulsion of polypus; autopsy.)—*Dalby*, Journal de Med., etc., T. XI., pp. 42 and 370, 1759.—*Morgagni*, De sedibus et caus. morb., Epist. XXI., Cap. 20, 1760.—*Senac*, Traité du cœur, I., 4, ch. 3 and 2.—*Leboeuf*, Mémoires de l'académie de chirurgie, 1764.—*Marcorelle* and *Butler*, Acad. des Scienc., 1762.—*Van Swieten*, Comment. in Boerhave Aphorism., Tom. IV., p. 31, aphorism. 1199. Hildburgh.,

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Consult, in addition, the manuals and treatises on pathological anatomy and on
special pathology and therapeutics.

Introductory Remarks and Etiology.

The form of disease under consideration has been discussed
by individual authors under very different appellations. It is
sometimes designated as *bronchial croup*, sometimes as *fibrin-
ous bronchitis*, and sometimes as *pseudomembranous bron-
chitis*. In olden times the term *bronchial polyps* was fre-
quently employed to designate the pathological products.
Lebert designates the disease as *fibrinous bronchitis*, "because
the fibrinous nature of the inflammatory product constitutes its
chief characteristic; the fibrine, in this affection, exuding as
such from the bronchial capillaries or the pulmonary capillary
vessels, in company with the white corpuscles, or perhaps escap-
ing as fibrinogen which promptly coagulates on exposure to air."
The term *croupous bronchitis* is still employed by most authors.

As already mentioned, we shall take into consideration here
only those cases in which *the croupous process has originated in
the bronchi*. From an anatomical standpoint, we must include
under the term croupous bronchitis all those cases in which
fibrinous products in general are deposited upon the bronchial
mucous membrane, whether they occur there as a primary dis-
ease, whether the croupous process has become secondarily
extended upon the trachea and the bronchi, or whether it is as-
sociated with croupous pneumonia and the like. From a prac-
tical stand-point, on the contrary, these individual forms possess
each a very different significance.

As we shall take into consideration here only the form men-
tioned above, the remark must be premised that a large number
of observations are recorded in medical literature which are
valueless for any accurate analysis, on account of their incom-

pleteness or want of details.   Lebert,[1] in the careful compilation made by him, found thirty-two such cases recorded.

Croupous bronchitis, as a genuine primary form of disease, *is a very rare affection, and one which occurs more frequently in the chronic than in the acute form.*   Its occurrence is so infrequent that even in large hospitals years and decades may pass before a single case of the kind comes under observation.   Of acute fibrinous bronchitis, with fibrinous expectoration, Lebert could find but seventeen observations,[2] after a careful analysis of all the cases known at the time of writing.

As regards the etiology of this form of disease, we are in possession of hardly a single well-established fact.   The disease, in both its acute and chronic forms, is observed *more frequently in males than in females.*   In the acute form, according to Lebert, the proportion of men to women is 11 : 6, or nearly as two to one ; in the chronic form, according to the same author, it is nearly 3 : 2.   Biermer,[3] who has analyzed fifty-eight cases, records nineteen in females and thirty-nine in males.

As to the *age* of the patient, the disease is observed far more frequently in youthful subjects.   On the other hand, it occurs tolerably seldom in childhood, and still less frequently in advanced age.   *Most of the cases observed occurred between the tenth and the thirtieth years of life ;* below this period it was always less frequent, and it occurred in but few instances at advanced age.   Only a couple of cases have been observed in early childhood.   The oldest subject was seventy-two years of age ; and with reference to this case it is to be remarked that this individual had already had fibrinous expectoration, from time to time, for seven or eight years (Goumoëns' case, l. c.).

As to *previous health and vigor*, it is to be remarked of the subjects affected with the disease, that in many cases no special injurious influence had been previously apparent, and the state of constitution had been good.   On the other hand, in the greater number of the cases the appearance of real bronchial croup was preceded by repeated attacks of *acute or more chronic*

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[1] Klinik der Brustkrankheiten, I. Bd., 1 Hälfte, p. 110.

[2] L. c., p. 117.

[3] L. c., p. 718.

catarrh; so that a predisposition to catarrh seems to be a favoring preparatory condition for the occurrence of bronchial croup.

In other cases, *physical debility from previous disease* has been noticed, and this, perhaps, has increased the predisposition to the affection. According to some, *pregnancy* and *menstruation* have had, in a few cases, a certain though very remote relation to the occurrence of the disease. Of interest, in this connection, is the case reported by Schnitzler,[1] in which the attack followed the menstrual period. In several cases the disease occurred during pregnancy. Besides this, there seems to be a special predisposition to this disease in many families. A number of observations are on record in which *several members of the same family became affected with the disease.*

Position in life does not appear to exert any influence. The disease has been observed both in the well-to-do classes and in the poorer classes, and any special preponderance of cases in one or the other station of life has not yet been established.

Just as little special preponderance is known as regards *locality* or *nationality.*

In general, however, the frequency of bronchial croup appears to have borne a certain relation to the frequency of bronchitis. Whether the greater frequency of bronchial croup in Switzerland, spoken of by Biermer, is simply accidental, or actually due to local conditions, can only be determined by a large series of statistics. As yet the reports of cases of bronchial croup are so scanty, that the fact that most of the known cases have occurred in Germany and in England cannot justify any conclusion as to the greater frequency of the disease in these countries. On the other hand, as advanced by Biermer, *the infrequency of croup in southern climes seems to apply to croupous bronchitis also.*

Unfortunately, in the cases reported, the data regarding the frequency of occurrence of the disease *at different seasons* are too scanty for statistical purposes ; nevertheless, it seems highly probable that the majority of cases were observed in the spring, especially towards the end of spring, that is, at the same period in which pneumonia most frequently occurs. Hence, croupous

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[1] Wien. Med.-Halle, V., 44, 46, 1864.

bronchitis, like pneumonia, probably owes its development in a measure to the great daily variations of temperature and the like which occur at this period.

Atmospheric influences, and taking cold, have generally been regarded as playing the same part in the production of this disease that they do in the production of catarrhs of the respiratory organ, and especially of pneumonia. Exactly what is the association between these sources of injury, and the croupous bronchitis thereby occasioned, is by no means clear. On the other hand, there are at least an equal number of observations in which the disease became developed without any evidence of the influence of any such cause.

While the disease begins suddenly in one series of cases, without being preceded by any disturbance on the part of the organs of respiration, especially by catarrh, yet in a much greater number of cases the appearance of the disease is preceded by simple catarrh for a longer or shorter period. There is so much reason for considering the latter as the rule that bronchial croup appears to take its origin from an ordinary bronchitis. This bronchitis preceding the croupous exudation is sometimes acute, sometimes more chronic. In many cases it is of such short duration that the symptoms of bronchial croup follow almost immediately upon the commencement of those of bronchitis. These symptoms, as we shall see later, are especially characterized by very severe suffocative paroxysms. In not infrequent instances, as in one of Biermer's cases, the manifestations of bronchial croup are preceded for a long time by those of *tuberculosis.* *Hæmoptysis* has also been observed as a precursor of bronchial croup, and on this account a closer connection has been supposed to exist between tuberculosis and croupous bronchitis. It is to be remembered that croupous bronchitis itself frequently occasions hæmoptysis, without tuberculosis, and that, therefore, every hæmoptysis that occurs is not to be referred to a tuberculous origin. According to the observations thus far recorded, we must express the opinion, with Biermer, despite the opposite views of some, that an intimate connection between tuberculosis and bronchial croup in no wise exists, or at least has not as yet been proven.

So, also, not even the remotest connection with croup has been proved in any of the different *dyscrasic* conditions. Neither of *syphilis, rachitis, scrofulosis,* nor of other similar morbid processes has it been proven that they stand in any closer connection with the occurrence of bronchial croup. A rachitic shape of the thorax has been mentioned in the case of several children who were affected with bronchial croup ; but not in the remotest manner do they show any closer association between these two affections. On the contrary, numerous facts indicate a merely accidental coincidence. Rachitis, like scrofulosis, syphilis, chronic alcoholism, and similar affections, may well favor the occurrence of bronchial croup, in so far as it enfeebles the general constitution ; but there can be no thought of any further relation between the two.

From what has been said it is evident how defective our knowledge of the etiology of bronchial croup still remains. All the causes mentioned may play a certain part in the production of this form of disease, but only a very remote one. A special predisposition, or the influence of some special unknown agency, is always essential in addition. In what this consists the observations thus far made have not yet been able to determine.

Forms and Course of Fibrinous (Croupous) Bronchitis in General.

As already remarked in our introduction, bronchial croup progresses under two different forms, *acute* and *chronic. By far the greater number of cases yet observed belong to the chronic form.* On the other hand, the acute form of genuine bronchial croup has as yet been observed only in a small number of cases. Lebert has been able to collect but seventeen instances, in a recent compilation made for the first time from the entire range of medical literature.

We will first consider the *acute form* with reference to its course. The disease may begin in the form and manner of an ordinary acute catarrh, with slight fever, more or less dry cough, feeling of oppression on the chest, loss of appetite, increased

thirst, and similar symptoms. After these simple catarrhal symptoms have existed for some days, severe symptoms occur more or less suddenly, including intense dyspnœa, increasing to manifestations of suffocation, active febrile movements, dry, harsh cough, usually without any or with but scanty expectoration, severe oppression and feeling of anxiety, sometimes even slight hæmoptysis. In other cases, on the contrary, the symptoms of actual fibrinous bronchitis are not preceded for a longer or shorter period by the symptoms of simple catarrh, but the disease begins at once with very urgent symptoms, sometimes even with a severe rigor, which may then be repeated several times, high fever, intense dyspnœa, and severe, tormenting, long-continued paroxysms of cough. *Great dyspnœa*, associated with marked sensation of oppression in the chest and dread of suffocation, *is almost never wanting in this form*. In some cases the commencement has been just like that of a pneumonia (as a matter of course, without the later development of this disease), ushered in, that is, with chill followed by heat, pain in the side, and similar symptoms. In other cases symptoms of angina have preceded all others. The cough is usually at first dry, harsh, and shrill; often extremely severe and tormenting; but not hoarse and muffled, for the larynx remains totally unaffected in this form of affection. If sputa are expectorated, they represent, at first, merely ordinary catarrhal sputa. The expectoration frequently exhibits admixture with blood; sometimes the amount of blood discharged is somewhat greater, amounting to a tablespoonful and more. In its further course, usually, however, only after the lapse of several days, *the characteristic fibrinous expectoration* becomes manifested; the character of which we shall consider more closely in our analysis of individual symptoms. Fibrinous masses, or fragments thereof, originating in the bronchi, are only exceptionally expectorated during the first few days of the disease. Their expectoration occurs almost always with very violent straining. The discharge of these masses is immediately followed by relief. Not infrequently the first expectoration of the casts is associated with hæmoptysis. In other cases, on the other hand, the discharge of these fibrinous masses does not take place. In one case

(Oppenheimer) even the otherwise constantly observed and often very tormenting cough was absent.

Symptoms referable to the *larynx* are wanting in this form, as are also the peculiar *symptoms of stenosis of the larynx.*

Of the *physical methods of exploration, auscultation,* especially, reveals important deviations from the normal condition. *The respiratory murmur is always absent where large bronchial casts are firmly adherent,* while the sonority of the percussion sound remains. According as the bronchi are more completely and in greater number occluded by fibrous masses, so must the normal respiratory murmur be suspended over a greater surface.

The *course* of this acute form is such in severe cases that the symptoms mentioned constantly increase; soon *symptoms of asphyxia, stupefaction,* and *somnolence* become superadded, and with constant increase of these manifestations a fatal termination finally follows. In many cases towards the end the process becomes extended upon the trachea and the larynx, so that the symptoms of stenosis of the larynx are superadded to those mentioned. This complication, however, is of rare occurrence.

If the disease inclines towards improvement, then the manifestations of dyspnœa gradually subside after the expectoration of larger or smaller branched casts, usually with the aid of very violent coughing, and with notable straining of all the forces of expectoration. Sometimes these casts are expectorated coiled together in a large ball; sometimes, again, in separate fragments.

The *duration of the acute form* extends usually over only a few days in those cases which are to terminate fatally. The shortest duration was three days, the longest fourteen days. In cases which are not fatal the course of the disease is somewhat more protracted.

In reference to the *frequency of fatal cases* it is to be remarked that, according to observations thus far recorded, *nearly half* the cases terminate fatally.

The *course of the chronic form* of the disease is very different. As a rule, the symptoms of chronic fibrinous bronchitis are

preceded for weeks and months, even for years, by those of ordinary bronchitis. After a shorter or longer continuance of these catarrhal symptoms, severer symptoms become manifested, severe paroxysms of cough, intense dyspnœa, and the like, the disappearance of which is coincident with the expulsion of the fibrinous masses. Much less frequently the commencement of this chronic form is the same as has been described for the acute form, so that the disease appears at first with the train of acute symptoms already described, and then in its further course acquires a sluggish character.

Sometimes the appearance of the symptoms of fibrinous bronchitis are preceded by symptoms of pulmonary phthisis with or without hæmoptysis, of exudative pleuritis, and the like, so that, in other words, the fibrinous manifestations become superadded to one of the diseases just named. Slight attacks of hæmoptysis, especially, are not unfrequently observed as a symptom in this affection, independently of the existence of tuberculosis.

In several of the cases acute laryngeal catarrh, with hoarseness, occurred in the commencement, at the same time as the prodromal bronchitis.

The further course of this chronic form may vary very much. Those cases which are attended only with the symptoms of an ordinary bronchitis, in which the occasional expectoration of branched casts forms the only deviation, pursue a non-febrile course, as a rule. This form may continue for long periods, even for years, without affecting the general condition to any considerable degree. The symptoms undergo exacerbation from time to time, the catarrh becomes more severe, moderate dyspnœa is superadded, and the cough becomes more severe by paroxysms, and after the expulsion in one of these paroxysms of a larger or smaller cast the symptoms again subside, and the previous feeling of relative comfort returns. Sometimes these casts are expelled with tolerable facility and without special straining.

There are numerous *transition forms* between this mild form, progressing without any important injury to the general condition, and the severest form, in which the intense suffocative paroxysms set in, and in which, after a short time, the strength

and the nutrition of the patient suffer in a great degree. In its higher grades the chronic form of bronchial croup presents an extremely tormenting affection, although usually not directly dangerous. Excessive want of breath, intense anxiety and sense of suffocation, tormenting paroxysms of cough, in short, the same train of symptoms that we have already seen in the acute form, characterize the severer grades of the chronic form also, so that in these cases the chronic form presents nothing but a series of acute or subacute attacks, with shorter or longer intervals of complete freedom, or simply of ordinary bronchitic manifestations. These cases, then, like those of the acute form, are not infrequently attended with fever, sometimes slight, sometimes more severe. With the frequent recurrence of these severe attacks it is self-evident that the vigor and nutrition of the patient must suffer in a great degree.

The duration of this chronic form is very various. As already remarked, in chronic bronchitis the affection does not consist so much of a single attack, as of a prolonged series of attacks which recur at intervals of varying lengths. Thus the duration of the entire affection, including the intervals between the attacks, may extend over many years. Cases have been repeatedly observed of seven and eight years' duration, and even longer. In a case reported by Walshe, the duration of the disease extended, with slight intermissions, over fourteen years.

Just as the general duration of fibrinous bronchitis varies to a considerable degree, so also is *the duration of the individual attacks very variable*, and in like manner *the length of the interval* between the individual attacks varies notably. In many cases, chiefly mild ones, the expectoration of bronchial casts ceases after a few days, to recur only after a long period. It happens in infrequent instances that the entire process reaches its conclusion with one or two discharges of bronchial casts. This takes place with greatest relative frequency in cases in which the croupous bronchitis has become established as a temporary complication in other chronic pulmonary affections, especially tuberculosis. As a rule, the individual attacks in idiopathic bronchial croup continue longer than in the acute form ; sometimes they last through several weeks, and even for

longer periods. It frequently happens, too, that at one time the attack will be a short one, and at another time, a very long one.

Finally, it is worthy of mention, that the *recurrence* of the attacks always *takes place in an irregular manner*. Only in a single case has a certain regularity been observed.

Anatomical Changes.

The great rarity of the disease, and the greater infrequency of opportunity for post-mortem investigation, renders it not surprising that the anatomical relations of croupous bronchitis are not yet sufficiently elucidated in all their details. In the absence of personal knowledge of post-mortem conditions, we will describe the anatomical relations in accordance with the reports recorded in medical literature.

Sometimes the croupous process in the bronchi attacks a part of the trachea and most of the ramifications of the bronchi, and sometimes it is confined to individual branches of the bronchial system. The first may be designated, according to Biermer, as the *diffuse*, the latter as the *circumscribed form*. The former extending from the trachea into the minutest ramifications of the bronchi, is chiefly encountered in the acute form. The croupous masses behave differently in different cases. Sometimes they adhere firmly to the walls of the bronchial tubes, and sometimes they lie free within them separated somewhat from the walls by mucus or air. Sometimes they may be entirely absent in the cadaver, although croupous casts have been expelled in considerable quantity during life.

The *fibrinous casts* are either expelled alone, rolled up in the form of a ball, surrounded only with a little mucus, or they are enveloped in a considerable quantity of catarrhal, purulent, or sanious sputa. The latter condition is observed in the milder forms of croupous bronchitis, and recalls the appearance of similar fibrinous products of inflammation in pneumonia, the frequent occurrence of which was first indicated by Remak.

The recently expelled bronchial cast usually forms an irregular, skein-like mass, sometimes of a whitish-yellow, sometimes of a reddish flesh color. The latter color is usually due to admix-

ture of blood on the surface. For more careful inspection and separation from other admixtures, the entire stringy mass is to be washed in water and spread out upon a support. It is then at once seen how the original mass resolves itself into a series of branching ramifications, which are again resolvable into smaller and smaller subdivisions, accurately corresponding to the subdivisions of the bronchi. In complete specimens casts of even the terminal bronchi and infundibula can sometimes be detected. In the latter case the ends of the casts are not sharp, but club-like.

In cases in which the expectoration of these casts is often repeated within short periods, it can be readily demonstrated *that the casts expectorated at different times, frequently exhibit exactly the same length and thickness of trunk, branches, and twigs.*

The length and thickness of the casts are different in different cases. As Biermer justly remarks, we can, under certain circumstances, learn from the *form of the ramified cast,* whether it originates from the upper short-branched divisions of the bronchi, or from the lower and more gradually branching ones. Thus, casts from the upper bronchial divisions are marked with somewhat shorter branches, which promptly divide into numerous delicate prolongations; while in those from the lower portion of the lungs, on account of the greater length of the subdivisions of the bronchi, the change into smaller and smaller prolongations is more gradual. Their *length* is, therefore, also of importance, inasmuch as we can determine with certainty, by a certain length of a cast, that it could not have come from the bronchi of the upper portion of the lung.

These casts are on an average from three to six centimetres in length, but they sometimes reach the length of ten or twelve centimetres. Their thickness often does not entirely correspond with the calibre of the affected bronchial twigs. As a rule, the main stem is not thicker than a goose-quill. In less frequent instances it reaches the thickness of a lead-pencil or even that of a little finger. In a case recently reported by Kretschy,[1] which terminated fatally, the length of the entire cast reached

[1] Wien. med. Woch., 1873, 14, 15, 16.

eleven centimetres ; and the thickness of the main stem was about one centimetre and a half.

In the majority of cases the cast is not solid, especially in its thinner branches, but is hollow and filled with mucus and air. The thicker stems are usually solid and fibred longitudinally; the thinner stems are much more frequently hollow ; and the thinnest stems again are delicate, solid threads. Even in preparations preserved in alcohol, the pearl-like rows of the air-bubbles can often be seen.

On cross-section, especially in the thicker tubes, we can usually recognize a *lamellar structure in concentric layers.* This indicates that the deposit of fibrine has taken place at intervals. The innermost ring represents the oldest deposit of fibrine, on which, then, a second, a third, and subsequent layers have been deposited. This arrangement in layers can be best seen in alcoholic preparations. The individual layers differ greatly in thickness ; internally there may be a tubular canal ; sometimes, however, the cast is apparently solid. Thus the alcoholic preparations, in the case reported by Kretschy, showed four delicate, thin, transparent lamellæ of different thicknesses, only in the larger pieces there was a central layer of membrane many times folded, which was connected with the lamellar wall by means of delicate horizontal folds. These relations, as a matter of course, may vary very much in individual cases, according to the rapidity with which the membranes are formed.

As to their *form*, we have already mentioned that they do not usually present an entirely smooth surface. The expression, cylindrical in form, generally applied to these casts, does not fully describe their appearance. Bulging or knotty swellings are observed in places ; and the thicker stems are not always round, but are sometimes somewhat flattened (Biermer). These bulging and spindle-shaped places are not ordinarily, according to Biermer, to be regarded as impressions of bronchiectatic dilatations, but are due to the circumstance that the croupous exudation, in coagulating, finds obstacles at some places, and is thus prevented from being so completely drawn together. Mucus and air are usually enclosed in these bulging portions, just as between the different layers. The enclosure of air within these

layers is readily explicable by the rapidity with which they are often deposited. A second explanation of the formation of these thicker portions, when solid, is recognized by Biermer, in the secretion of unequal quantities of coagulable material at different points.

Sometimes the casts exhibit small spiral turns about their axes, especially in their thinner branches.

Späth [1] alludes to another special peculiarity of these casts. On nearly all the casts examined by him, the upper end, in the direction of the trachea, was obliquely cut off ; which indicates, according to him, that the croupous exudation is only partially continued from the bifurcation of a bronchus, the larger portion of the bronchus remaining free. Späth regards this as an important point for the theory of the mechanism of the expectoration. He believes that the end of the cast thus projecting is torn loose by the expiratory current of air in the same manner as in embolism ; and that thus the entire cast, loosened moreover by the action of the bronchial muscles, can be forced out.

The *consistence* of the bronchial cast is usually tolerably compact, and firmly elastic. The finer stems have sometimes a somewhat softer and gelatinous consistence. Frequently, the casts are no longer as firm towards the end of the disease as at the height of the attack.

The *color*, as a rule, is milk-white, or yellowish-white ; sometimes mother-of-pearl. The *superficial surface*, especially immediately after expulsion, occasionally shows a bloody tinge, sometimes more uniform, sometimes more in the form of separate stripes, which, by some observers, have been incorrectly regarded as capillary blood-vessels.

Microscopic examination of the cast reveals, as a rule, a structureless, hyaline basement substance, between which cellular elements are thickly pressed together, principally composed of pus corpuscles. In most instances but few or no red blood-corpuscles are enclosed within the fibrinous masses, though they are not infrequently found on the surface.

In a case recently reported by Waldenburg,[2] the thicker

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[1] Würtemb. Corr.-Bl., XXXVI., 8, 1866.
[2] Berlin. klin. Woch., 1869, No. 20.

stems exhibited numberless fat globules and but very few mucus and pus corpuscles, contained in a slightly fibrillated but otherwise hyaline basement substance. The finest ramifications contained only a few small fat globules, but, on the other hand, numerous mucus and pus corpuscles. A good deal of fat was detected in the masses by chemical examination also.

Sometimes a few cells of cylindrical ciliary epithelium, and like elements are enclosed in the casts. Connective-tissue elements and capillary vessels are not found in them.

The chemical relations of the casts correspond with those of coagulated albumen in general, viz., insolubility in water and table salt, and solubility in alkalies, especially in lime-water (the latter fact known to Dixon [l. c.] in the last century [1783]). The addition of iodine tinges the cast yellow; diluted muriatic acid makes it swell.

The other masses, sometimes expelled simultaneously with the casts, are usually only simple catarrhal sputa, with sanguineous admixtures. In the majority of cases, as already mentioned in describing its course, a simple bronchitis is associated with the croupous exudation.

The mucous membrane of the affected bronchi is sometimes deeply reddened and injected, and sometimes again it is pale. Accurate indications as to the condition of the epithelial layer are wanting in many cases. Biermer found, in the one case which he dissected, the epithelium still remaining beneath the loosely lying casts. In the expectorated casts often examined by him he found only round cells, but no cylindrical epithelium enclosed. On the other hand, in the case reported by Kretschy, the epithelium had disappeared without leaving a trace at the place occupied by the plug in the corpse,—having either undergone metamorphosis or exfoliation. In this case also, contrary to what was found in Biermer's case, cylindrical and ciliary epithelium were found upon the plugs last expelled.

According to Kretschy's view, the blood only can be the source of the rapid and inexhaustible supply of fibrine as the cementing substance for the croup-membrane, and not the epithelial cells; the escape of cells also taking place from the blood-vessels. Kretschy therefore, on the basis of his case, de-

cides that the croup-membrane is formed by the transudation of a fluid albuminous substance (fibrine), hardening rapidly after its secretion, and the exudation of white blood-corpuscles, and that it is not due to a peculiar metamorphosis of the epithelium of the bronchial mucous membrane, in which the epithelium forms the cellular elements, by endogenous formation of new cells, and the fibrinous framework out of the remaining cellular substance. According to this, the deposit upon the mucous membrane in acute croupous processes would be the result of a formation of fibrine from transuded blood-plasma and exudation of young cell elements ; in short, the process would be exudative.

The submucous tissue may, as in laryngeal croup, become swollen and infiltrated with serum. On the other hand, extensive ulcerations of the mucous membrane have not yet been observed.

As to the condition of the *parenchyma of the lungs*, it may be remarked that only exceptionally does it remain entirely normal. In cases of long continuance of the affection, especially, alterations are almost constantly found ; but even in the acute course some alterations are also found, at least in the majority of cases.

A portion of the alterations found in the lungs at the autopsy are not to be regarded as the result of the bronchial croup, but as having preceded its appearance for a shorter or longer time. This applies, for example, to many cases with tuberculous complications.

Among the peculiar consequences of bronchial croup we have to mention principally emphysema, or acute dilatation of the lung, and in addition atelectasis, lobular, and less frequently lobar thickening, cirrhotic induration, and circumscribed purulent inflammation. The pleurisy observed in several cases of bronchial croup was not to be regarded as a secondary affection, but as a complication of the primary one.

Symptomatology.

Analysis of Individual Symptoms.

Having already delineated the course of bronchial croup in

its main features, it now remains to give a short description of its individual symptoms.

Among these the expectoration of bronchial casts presenting the form of the bronchial ramifications is the first one to be considered. The *quantity* of these casts varies considerably in individual cases. Thus, instances are recorded in which from eight to ten and even more casts were expelled daily ; in one case, indeed, the patient is said to have repeatedly expelled through mouth and nose several cupfuls of casts within a few hours (?).

These casts are either expectorated alone, rolled up in the form of a ball, mostly enveloped in a little mucus, or they appear as admixtures in a mass of expectoration, which is sometimes of a more mucous character, sometimes more purulent, and sometimes again more or less bloody. We cannot, as a matter of course, form any definite opinion from the quantity of casts expelled, as to the size and quantity of the casts formed within the bronchi. In those very cases in which the croupous product is extended over the largest portion of the bronchial tree, there is frequently no expulsion of casts, inasmuch as the current of air is no longer able to detach them, or is only able to do so partially. Thus, then, the expectorated casts furnish no correct indication of the extent of the croupous process.

In view of the rapidity with which these casts appear, even when much subdivided, the fact above mentioned of the relatively great quantity of casts is readily comprehensible. Thus, in a case recently reported by Kretschy from the clinic of Duchek, a second plug was coughed out twenty-eight hours after the first expulsion of a bronchial cast ; twenty-seven hours later another cast of the bronchial tubes was expelled, exactly like the previous one ; twenty-four hours afterwards another one, and so on. All these casts, seven in number, were of exactly the same length and thickness in trunk, stems, and branches, and had all been produced, as proved by the autopsy, in one and the same place (middle and lower lobes of right lung).

With casts of a certain size, it is easily comprehensible how,

with relatively slight force of coughing, their expulsion is only possible in the form of separate fragments, or no longer possible at all, especially when they adhere firmly to the walls of the bronchi. In this way a fatal termination often results in very acute cases, without the expulsion of a single cast.

Besides the power of the muscles of expiration and the size of the cast, the connection of the separate lamellæ with each other, and especially with the bronchial walls, has an influence upon the difficult or easy expulsion of these masses.

The lamellar structure of these membranes, which frequently inclose bubbles of air, shows that the exudation occurs at successive periods. According to the rapidity with which the individual membranes appear, a greater or a less quantity of air can become enclosed between them. Thus, in one case the to-and-fro current of air is still competent to partially loosen one lamella from the others, while it is incompetent to do this in a second case. All these conditions, therefore, must vary according to the intensity and extent of the different factors mentioned.

As already stated, these casts, are sometimes expelled by themselves, merely mingled with traces of mucus, sometimes with admixture of sero-mucous or muco-purulent sputa, and not altogether infrequently with bloody masses. In cases in which but scanty quantities of these casts are expelled, and in which they float in abundant sero-mucous or muco-purulent masses, they may be readily overlooked in a superficial examination. The mucous masses, as a matter of course, are but the product of a contemporaneous acute or chronic bronchitis, with which, as previously observed, croupous bronchitis stands in intimate connection.

It not infrequently happens, however, that bloody masses, even in large quantity, are mixed with the fibrinous masses. These bloody admixtures are usually due to rupture of blood-vessels during the severe paroxysms of cough occasioned by the casts, and by the loosening of these masses. Hæmoptysis, therefore, is not infrequently observed in bronchial croup, even without the existence of tuberculosis. Sometimes it precedes the discharge of the cast, and sometimes it attends it. Only exceptionally is the hæmoptysis severe.

The expulsion of the cast in most instances does not take place in the same manner as the expectoration of ordinary sputa, but almost always in the form of more or less violent paroxysms. These paroxysms may be exceedingly severe under certain circumstances, and attended with intense dyspnœa and exceedingly tormenting and straining efforts to cough. They sometimes precede the expectoration of the fibrinous masses for a longer or shorter period, at times even for an entire day. When the extent of the croupous process is circumscribed and limited to a small surface, the dyspnœa is correspondingly less severe, and attended with correspondingly less alarming manifestations. With the expulsion of these fibrinous masses, the picture usually changes at once. The dyspnœa, the severe paroxysms of cough, the cyanosis thereby occasioned, and all the remaining symptoms usually disappear at once after the expulsion of the mass ; and this relative feeling of comfort continues until fresh casts have again been formed, when the same series of symptoms are occasioned as were excited before. The more quickly these masses are formed, the sooner the old severity of symptoms returns. The often rapid re-formation of these croupous masses renders it comprehensible how, in acute cases, the dyspnœa may be almost continuous.

While the train of symptoms is extremely stormy, as a rule, in severe acute cases, the expulsion of the casts being accomplished only by very violent coughing, there is a series of cases, on the other hand, in which the expectoration is accomplished with tolerable facility. In the first place, there are cases in which the croupous process involves but a slight extent of surface. Here, therefore, the breathing is less impeded, and the provocation to cough is slighter. Then as a further favorable element comes the fact that these casts now remain longer in the bronchi, and may thus undergo retrogressive metamorphosis, by which they are gradually softened, loosened, and raised from the bronchial wall. In these cases, slight coughing suffices to expel the casts.

The *voice*, in the majority of cases, is slightly, if at all, altered. If there is hoarseness, there must be some complication. Pure, uncomplicated bronchial croup, as such, never

causes any real alteration in the voice. Slight grades of laryngeal catarrh, which are attended with a moderate enfeeblement and roughness of voice, are, of course, not infrequently associated with bronchial croup. It is fully in accordance with what has been mentioned that the so called croup-cough, constantly observed in laryngeal croup, is absent in bronchial croup.

Febrile movements are usually present in acute cases only, or in cases complicated with other affections. Sometimes the attack is ushered in by an actual *rigor*, which often appears suddenly and unexpectedly. Such a condition, for example, was observed by Kretschy. In his case the patient, while promenading, was suddenly attacked with severe rigors, lasting an hour and a half, having felt quite well until that moment. The rigor was followed by severe straining cough and dyspnœa, and then, but not until twelve hours later, a reddish, fleshy lump was expelled, which, on close examination, proved to be a bronchial cast. The paroxysms were repeatedly ushered in by rigors in this patient. In other cases there was nothing of the kind. The temperature sometimes indicated tolerably high figures. With the termination of the paroxysm the normal temperature usually returns, if there is no counteracting complication.

Sweating is not infrequent during the paroxysms, and especially during the severe paroxysms of cough.

Venous hyperæmia and *cyanosis* are not infrequently observed; but they subside with the disappearance of their cause of origin. Dropsical manifestations are only exceptionally observed as a result of the disturbed relations of the circulation. Severe grades of dropsy are always indicative of some complication.

In the decidedly acute forms the *nutrition* does not suffer, as a rule, or if so, only in an insignificant degree; it is only in very severe chronic cases that it suffers to any considerable degree. On the other hand, there is a series of chronic cases, although severe, in which the general nutrition does not suffer notably, despite long continuance of the malady.

The *subjective symptoms* vary not inconsiderably in the dis-

ease under consideration. Stitches in the side are observed only in few cases, and are apparently due to complications with inflammatory affections of the pleura. Sensations of pressure and soreness in the breast are not infrequently observed. On the other hand, severe pains are absent in the great majority of cases. When numerous bronchi are occluded, feelings of anxiety are by no means infrequently experienced by the patient, and these are nearly proportional to the severity and acuteness of the process.

As to the special *physical signs* of bronchial croup in its limited signification, they may be entirely absent under certain circumstances, as when the process is limited to but few and very small bronchial twigs. All other symptoms may be wanting, save those of catarrh ; so that it may be impossible to determine the seat of the affection with certainty.

It must, however, be borne in mind, that even the most accurate physical exploration is never competent to the recognition of bronchial croup as such, even in the severest cases. In pronounced cases the symptoms are similar to those more or less characteristic of bronchial stenosis, whether due to syphilitic cicatrices, or to the impaction of a foreign body, or to any other cause.

Percussion shows no important diminution of resonance in pure uncomplicated cases, no matter over how many ramifications the obstruction in the bronchi may extend. In cases of complication with atelectasis, lobular or lobar pneumonia, and the like, the percussion sounds will indicate the well-known changes incident to these affections.

The *respiratory murmur*, as is self-evident, must cease at those places, the bronchi leading to which are occluded by casts. Hence it may be considered as a somewhat characteristic trait of this affection that while on the one hand the percussion tone is full and clear, the respiratory murmur, on the other, is absent.

These symptoms of bronchial obstruction continue so long as the casts are not loosened from the bronchi and removed. When, therefore, after a paroxysm of cough, by means of which the coagulated masses have been expelled, the normal respiratory murmur suddenly again becomes audible at a place where

previously the physical signs mentioned in the last paragraph were observed, it is justifiable to draw the conclusion that the casts were formed in this locality.

Moist râles are not a special characteristic of the disease under consideration. Such râles are observed, temporarily, in almost every case of bronchial croup. On the other hand, an acoustic phenomenon has been repeatedly described, which is said to be due to the movements of the casts in the bronchi. This phenomenon, which has been considered to a certain extent as more or less characteristic, is sometimes described as a flapping valvular sound (Girandet), sometimes as a very loud whistling (Corrigan), sometimes as a bronchial friction-sound (Cane), and the like. That the cast, when it has become movable and oscillates to and fro in the respiratory current, may produce characteristic sounds, sometimes more of one character, and sometimes more of another, is easily comprehensible. Apart from the infrequency of the phenomenon, it cannot be considered as a pathognomonic manifestation.

By means of *inspection* we may determine the diminished respiratory activity of that half of the thorax, the principal bronchi of which are occluded by casts. This diminished expansion of the affected half of the thorax, coexisting with the full and clear sound on percussion, and with the absence of the respiratory murmur, suggests the thought that the bronchi must be obstructed, and also that the obstruction is probably due to the presence of bronchial casts. Even with complete occlusion of the principal bronchi, total inactivity of the side implicated is never observed, nor is it so marked as when the lung is completely compressed by pleuritic exudation, pyo-pneumo-thorax, or similar affections, but there is always an observable activity of the affected half of the thorax, though it is considerably diminished in comparison to that of the sound side.

It is evident that the more acutely the train of symptoms sets in, the more likely will we be to suspect the presence of a bronchial obstruction. The diagnosis, however, can only be made with certainty after the expulsion of the obstructing masses.

Diagnosis of Croupous Bronchitis.

The most important and only diagnostic sign is the expectoration of branching bronchial casts. All the remaining symptoms, individually or collectively, may readily mislead, and are never sufficient to establish the diagnosis with certainty. Bronchial casts may be mistaken even for coagula of blood, upon somewhat careful examination, in cases in which blood adheres to the bronchial cast.

As long as no bronchial casts have been discharged with the expectoration, just so long the diagnosis remains uncertain. In the majority of cases, however, expectoration of bronchial casts takes place sooner or later, and so the diagnosis becomes firmly established ; it remains doubtful only in those cases in which no masses are expectorated during the entire progress of the affection.

On the other hand, we may sometimes adopt the diagnosis of bronchial croup—with a very strong degree of probability in its favor—before the expulsion of the casts, in cases in which the symptoms described are present, and especially if the affected individual have already passed through one or more analogous attacks, which were followed by the expectoration of a bronchial cast.

The disease is most readily mistaken for *diffuse catarrhal bronchitis.* Although the dyspnœa, especially in adults, is not usually so great in the latter disease as in bronchial croup, this symptom has only a relative value, and hence very little weight can be attached to it. The absence, likewise, of the respiratory murmur, with preservation of full and clear resonance on percussion, may also be observed in these cases, though usually but temporarily. As a rule, the expiratory muscles are able, more promptly and readily than in bronchial croup, to overcome the obstacle existing in the bronchi.

In those cases in which bronchial croup occurs quite acutely and suddenly, a certain value is to be attached to the fact that the affection is limited to a circumscribed portion of the thorax, that is to *one-half of the thorax.* This sign loses its differential

diagnostic significance, as a matter of course, if the bronchial croup is ushered in by an extended bronchitis, involving both halves of the thorax, as not unfrequently seems to be the case.

To avoid the mistake of confounding this disease with *occlusion of the bronchi by a foreign body*, the history of the case should be very carefully considered. The physical signs of bronchial croup, and those of a foreign body in the bronchi, are very nearly identical. Where the history of the case cannot be ascertained, the affection may readily be confounded with the presence of a foreign body in the bronchi.

On the other hand, it is hardly possible to confound the disease with a free pneumothorax, even upon only a superficial examination.

It is also hardly possible to mistake the disease for *laryngeal croup*. The simple observation of the thorax during the phases of respiration suffices, in the one case, to indicate that the obstruction exists in but one-half of the thorax, or is at least intrapulmonic, and in the other case that it is connected with the larger air-passages, the larynx or the trachea. As to the manner of distinguishing between tracheal and laryngeal stenosis, we must refer the reader to the appropriate chapter on each affection. Both of them, however, are distinguished from bronchial croup by the so-called *inspiratory dyspnœa*,—the form of dyspnœa which occurs in all the affections dependent upon constriction of the upper larger air-passages. These two forms may also be distinguished from each other by numerous other symptoms, the enumeration of which in this place appears to be unnecessary. To mistake the disease for pneumonia or some other pulmonary affection is scarcely possible with careful physical exploration.

Complications, Duration, Termination, and Prognosis.

The acute form of bronchial croup, as already mentioned, runs its course in the majority of cases within from one week to at most several weeks; and in a relatively large number of instances leads to a fatal termination. In the majority of cases this acute form is not attended by any complications or morbid

sequelæ. It is only in those cases in which nearly all the bronchi in one lung are occluded that the sound lung, at least in many instances, becomes involved in disease, namely, in secondary pulmonic dilatation. In like manner, in almost every instance of sudden impermeability of a large portion of the lung, we find the intact portions, especially the edges, acutely dilated, as, for example, in ordinary acute pneumonia. This vicarious acute dilatation of the lung occurs the more readily the more quickly the obstruction is produced, and the severe dyspnœa and paroxysms of cough supervene, and it ceases with the disappearance of the cause of the injury ; that is to say, after the expulsion of the bronchial cast.

The chronic form of croupous bronchitis leaves consecutive disease behind it somewhat more frequently. An exact answer to the question as to the frequency of these consecutive conditions, based upon accurate statistics, is hardly practicable, owing to the fact that many of the cases published, in fact most of them, were not long enough under observation to render a satisfactory reply to this question possible.

As to the question whether bronchial croup does not lead to secondary tuberculosis, Biermer replies correctly that it is very rarely, or never, followed by tuberculous phthisis. He believes that the observations in which it is stated that the patients subsequently died of phthisis, plainly indicate that the patient was previously tuberculous.

On the other hand, emphysema and chronic bronchial catarrh are among the somewhat more frequent sequelæ of bronchial croup. Emphysema is to be regarded as occurring in the same manner as acute dilatation of the lung in occlusion of short duration. In rare cases infiltration of the parenchyma of the lungs is observed. Sometimes, furthermore, atelectasis of the affected portion of the lung ensues in consequence of the obstructed condition of the bronchi. Bronchiectasis has been observed at the autopsy in but two instances ; and in these it was not dependent upon the croup.

Finally, Biermer mentions the obliteration of individual peripheric bronchial ramifications, with fibrous induration of the surrounding pulmonary parenchyma.

As to *duration*, we have already stated that there are cases which run their course within a few days, and others which continue for months, and even years.   We therefore distinguish an *acute* and a *chronic* form.   The chronic form is further distinguished by often exhibiting very long intermissions, during which the patient feels perfectly well, and, at most, only the signs of a simple bronchial catarrh remain.   Severe exacerbations recur from time to time.   The duration of these exacerbations, again, may vary a great deal.

The prognosis is in general doubtful in acute cases.   According to the observations recorded, death occurs in about half of the acute cases.   On the other hand, *the prognosis of chronic bronchial croup is much more favorable.*   Recovery takes place in by far the greater number of cases, in so far as there are no serious complications which of themselves threaten life.

In making a prognosis, the acuteness of the process must be taken into consideration in the first place, and then the degree of its extent.   Age and constitutional vigor are of influence ; and so, likewise, the existence of further complications, as tuberculosis, for example.   Acute cases, in which the process is extended over a great number of bronchi, and in which the fever is of a high grade, always demand a doubtful prognosis.   The less the forced activity of the respiratory muscles succeeds in expelling the croupous masses, the graver the prognosis.   The early appearance of coma and marked cyanosis are always unfavorable prognostic indications, especially in feeble and emaciated subjects.

On the other hand, chronic cases which have become developed from simple bronchial catarrh, even when associated with turbulent manifestations, usually justify a favorable prognosis ; and this is the more favorable the smaller the section of the bronchial tract to which the croupous process is confined. Where, on the contrary, the patient is already enfeebled, where severe emphysema, tuberculosis, and other complications exist, the prognosis is much less favorable, as a matter of course.

Treatment.

Two indications are to be satisfied in the treatment : *first, to remove the fibrinous masses present in the bronchi ; and second, to prevent their reproduction.*

The first indication, it appears, can be most simply satisfied by the administration of *emetics.* On the other hand, it is to be taken into consideration that the bronchial casts are sometimes, especially at first, so firmly adherent to the bronchial walls that even the most forcible exertion of the abdominal muscles, and of the other muscles associated in the act of emesis, are insufficient to remove the fibrinous masses out of the bronchi. As long as the cast is still firmly adherent to the bronchial wall, the employment of emetics is useless, as a matter of course. Where, on the other hand, the casts are already loosened, the use of emetics will be serviceable and afford immediate relief. In the majority of cases we are not able to determine whether the fibrinous masses are still firmly adherent or are already loosened. The objection, further, has been not unjustly made to emetics, that they always tend to produce a diminution of strength. In spite of all this, I would recommend the use of emetics in this stage, especially as we possess in the recently introduced and amply tested muriate of apomorphia (Riegel and Böhm,[1] Siebert,[2] Quehl,[3] Jürgensen,[4] and others) an emetic which, with a convenient method of administration (by subcutaneous injection), acts very promptly, is always certain, and is free from unpleasant attendant effects. It is always possible to produce emesis with this remedy within a few minutes, and without special nausea ; as I have proven in a great number of patients. Besides this there are no unpleasant after-effects, the last trace of any unpleasant sensation caused by the remedy passing off in the course of a few minutes. Inasmuch, therefore, as this remedy does not produce the unpleasant effects which usually follow the administration of all other emetics, it should be employed experimentally even

[1] Deutsches Archiv f. klin. Med., IX. Band.
[2] Dorpater Inauguraldissertation, 1870.
[3] Inauguraldissertation. Halle, 1872.
This Cyclopædia, Vol. V., p. 233.

in cases in which it cannot be determined beforehand whether the casts are so far loosened that they can be readily expelled.

The employment of emetics should always be preceded, when possible, by the use of those remedies from which it may be expected that if they do not loosen the fibrinous masses they will at least soften them, and thus relax their attachment to the bronchial walls.

For this purpose inhalations of lime-water, lactic acid, and carbonates of the alkalies, and even of hot vapor of water, are especially to be recommended. Lime-water and the carbonates of the alkalies, in particular, are frequently employed to loosen croup-membranes. In mild cases this medication alone seems to be sufficient. Thus Waldenburg [1] reports the case of a girl, eight and a half years of age, who, for more than four years, had every few days expelled branched masses, the expulsion of which was accomplished only with great exertion; a whey-cure, however, and daily inhalations of lime-water, effected a recovery in the course of forty-five days. On the other hand, Waldenburg noticed that after the recovery from bronchial croup an impetigo of the scalp, which had existed for a long time, increased very much, thus suggesting the idea that possibly there was a certain nosological connection between the bronchial croup and the impetigo.

In cases in which the diagnosis is certain, Biermer [2] recommends an energetic mercurial treatment (calomel and gray ointment) in addition to the inhalation of the vapor of hot water or of lime-water.

The abstraction of blood is never called for in croupous bronchitis, unless required on account of special complications.

Finally, iodide of potassium has in recent times been repeatedly employed with advantage (see the observations of Wunderlich, Thierfelder, Sklarek, and others). In many of the cases reported, as in that by Sklarek [3] for example, the expelled cast was much looser, even on the second day of the use of the iodide of potassium.

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[1] Berlin. klin. Woch., 1869, No. 20.

[2] L. c., p. 732.

Deutsche Klinik, 1865, 32.

The use of alkaline mineral waters is also to be recom mended in chronic cases of bronchial croup.

The second indication of treatment is *to prevent the recur-rence of the attacks.* In cases in which the croupous bronchitis has developed in connection with an acute or chronic bronchial catarrh, it is advisable, first, to attack this bronchial catarrh. In addition to this, it is requisite, as a matter of course, to avoid all those sources of injury which experience has frequently shown to give rise to bronchial catarrh. The prophylactics recommended against simple bronchitis are therefore to be employed here also ; but this is by no means to be understood in the sense that this affection is to be regarded in a measure simply as an increase of such an existing catarrh, rather than an independent affection.

Where the general constitution is disturbed in any manner, as, for example, when there is scrofula, anæmia, and so forth, the use of the remedies applicable to these diseased conditions is indicated.

The employment of corroborant and alterant remedies is to be chiefly recommended in those cases in which the remedies first mentioned have not been of benefit.

A special enumeration of all the remedies which have been found apparently beneficial in a single instance by this or that author would be of no service here. There are no remedies, as far as is at present known, which are competent to prevent the recurrence of the attacks with any degree of certainty.

NARROWING OF THE TRACHEA AND BRONCHI; TRACHEOSTENOSIS; BRONCHIAL STENOSIS.

Albers, Erläuterungen, zum Atlas der pathol. Anatomie, II., p. 136; this author cites *Kerkringii*, Specilegium anatomicum, Obs. XXVII.—*Boneti*, Sepulchretum, Lib. I., Sect. XXII., Obs. II.; Lib. II., Sect. I., Obs. VII. and VIII.; Lib. II., Sect. II., Obs. IV. and X.; Lib. IV., Sect. I., Obs. XXXVIII.; Lib. IV., Sect. III., Obs. I., II.; further, Ephemerid. Nat. curios. Dec. III. a. III., Obs. 115; an. VII. and VIII., Obs. 129; an. IX., Obs. 119, Centur. IX., Obs. 15.— *Lieutaud*, Historia anatomico-pract., Lib. II., Obs. 845.—*Rush*, Med. Observations and Inquiries of a Society of Physicians in London, Vol. V., p. 96.—*Pet. Frank*, Interpretationes cliniceæ, P. I., p. 71.—*Heister*, Med. chirurgische Wahrnehmungen, No. 297, p. 843; Journal de méd., chir. et pharmacie, 1792, Juin; Revue médicale française et etrangère, Juillet, 1816, p. 120.—*Carmichael*, Magazin der ausländischen Literatur von Julius und Gerson, Bd. II.—*Saxe*, in Rudolphi's schwedischen Annalen, Theil I.—*Desault*, Chir. Nachlass.—*Malacarne*, in Hufeland's und Harless neuem Journal der ausländischen med.-chir. Literatur, Bd. III.—*Frank*, Klinische Erklärungen.— *Cassel*, Dissert. de gland. bronchialium morbis. Bonnæ, 1838.—Bulletin des sciences médicales, Janvier, 1829. (Case of great narrowing of the trachea in consequence of swelling of the mucous membrane.)—*Andral*, Clinique méd, 3 édit., T. III., p. 183, 1834. —*Reynaud*, Mémoire sur l'oblitération des bronches, Mémoires de l'academie de médecine, Vol. IV., pp. 117-167. Paris, 1835.—*Stokes*, Diseases of the Lungs and Windpipe. Dublin, 1837.—*Hasse*, Anat. Beschreibung der Krankheiten der Circulations- und Respirationsorgane. Leipzig, 1841.—*King*, A Morbid Flattening or Compression of the Left Bronchus, produced by Dilatation of the left Auricle, Guy's Hospital Reports, Vol. III., p. 175.—*Rokitansky*, Handbuch der pathol. Anatomie, III. Bd. Wien, 1842.— *Worthington*, Med.-Chir. Trans., 2. Ser., Vol. VII., p. 220, 1842. — *O'Ferral*, Dublin Med. Jour., Nov., 1843.— *Schulze*, Preuss. Vereinsztg., 23. Oct., 1844.— *Gintrac*, Bull. méd. de Bordeaux, Juin, 1844.—*Holscher*, Hannov. Annal., Bd. V., Hft. 2, 1842.—*Schillinger*, Oesterr. Woch., 1847, No. 7.—*Dittrich*, Prag. Vierteljahrschrift, 1849, I., p. 26. —*Piorry*, Traité de méd. pratique, III., 64 et seq.— *Wunderlich*, Handbuch der Pathologie und Therapie, III. Bd., 1850, p. 384.—*Bamberger*, Deutsche Klinik, März, 1850.—*Rokitansky*, Wien. Ztschr., VII., 3, 1851.— *Suchanek*, Prager Vierteljahrschr., X., 4, 1853.—*Chassaignac*, Compression de la trachée par les ganglions bronchiques, trachcotomia; Nouveau signe de diagnostic des engorgements ganglionaires du mediastin, Gaz. des hôp., 1853, No. 43.— *Wilks*, Constriction of the Right Bronchus, Med. Times and Gaz., No. 335, 1856; Trans. Path. Soc. London, Vol. VIII., 1857.—*Gross*, Elements of Pathological Anat-

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brane and submucous tissue, with partial necrosis of the cricoid cartilage
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Preliminary Remarks.

In the following pages, in which a short description will be given of narrowing both of the trachea and of the bronchi, not only those forms of stenosis will be kept in view which are produced by *intratracheal and intrabronchial alterations*, but those, also, which owe their origin to processes *external to the trachea and the bronchi*. On the other hand, we exclude those stenoses which are due to the entrance of foreign bodies; and likewise the stenoses occasioned by croupous bronchitis. Concerning the first, we refer the reader to the ensuing chapter; and concerning the latter, to the preceding section. So, likewise, all stenoses and obstructions of the smaller and minutest bronchi are excluded from consideration. We will first take up the *stenoses caused by compression;* then the *stenoses and obstructions occasioned by neoplasms;* and, finally, *the stenoses produced by disease of the tracheal and bronchial walls, by cicatrices, and the like.*

Stenoses of the larynx, generally described in common with those of the trachea, are excluded from consideration in the following pages for reasons already stated; while those of the trachea and bronchi will be considered in common; a separate description of either being made only in so far as the symptoms of the two forms of stenosis differ in important points.

In the following pages only the general conditions occurring in stenoses of the organs mentioned, can be described. A detailed description of all the variations that may occur, and especially of all the diseases which lead to stenoses of the trachea or bronchi; furthermore, an account of all the forms of

neoplasm that occur in this locality, the special surgical treat-
ment of these formations, and the like, cannot be undertaken
for want of space.   Concerning these points, therefore, we must
refer the reader to the monographs and to the special chapters
on these subjects.

Etiology.

Narrowing of the trachea or bronchi may occur in very
different ways.   From an etiological point of view these ste-
noses in general may be separated into *two chief groups :* 1st,
*those in which the cause of the stenosis lies external to the
trachea and the bronchi ;* and 2d, *those in which the constrict-
ing cause is to be found in the very walls of these tubes, or in
neoplasms taking their origin in them* (excluding foreign bod-
ies, which, as a matter of course, give the most frequent occasion
to manifestations of stenosis).   The first group of these stenoses
may be rudely comprised together under the name of *"stenosis
of compression,"* inasmuch as they are chiefly due to compres-
sion of the trachea or bronchi from without.   This form is
observed much more frequently than the second class.   The fol-
lowing are in general the most important and most frequent
sources of these stenoses :

Stenosis from goitre.   This includes actual hypertrophy of
the thyroid gland, the various forms of struma associated with
an enlargement of this organ, hemorrhage, inflammation, sarcoma,
carcinoma, and cystic tumors of the thyroid gland ; furthermore,
the echinococcus of the thyroid gland, which is of very rare
occurrence ; and so forth.   Of the latter affection Gurlt [1] has
collected the histories of seven cases, in three of which there was
great compression of the trachea.

In most cases in which one of the causes mentioned occasions
manifestations of stenosis, we find only the trachea compressed ;
but stenosis from goitre may sometimes involve even the bronchi.
Cases of the kind have been recorded by Demme and Metten-
heimer.[2]   In one of the preparations of the museum at Würz-
burg, described by Demme, the left bronchus was greatly com-

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[1] Ueber die Cystengeschwülste des Halses.   Berlin, 1855.

[2] Würzburger med. Zeitschr., III. Bd.

pressed by a cystoid tumor proceeding from the left lobe of the thyroid gland.

The seat of the tracheal stenosis, when muscular pressure predominates, is, according to Demme, chiefly the upper portion of the windpipe. Substernal goitre, as a matter of course, compresses the deeper portions of the windpipe.

As further causes of stenosis we have to mention : *swelling of the lymphatic glands at the hilus of the lungs and at the point of bifurcation of the trachea ; and swelling of the lymphatic glands of the anterior and posterior mediastinum.* These glands may undergo enlargement in various ways. In addition to simple hypertrophy, chronic inflammations with their various terminations—calcification, tuberculosis, and carcinomatous degeneration of these glands—have to be taken into consideration. The enlargement of the glands is sometimes very great, reaching the size of a hen's egg, and even a greater volume. The position of these tumors has more to do with the degree of narrowing than their size ; in the same way, as is well known, that very large goitres occasion manifestations of stenosis comparatively less frequently than tumors of relatively small size, but located in a certain manner. Thus, even the glands of the bronchi at the hilus of the lung may, under some circumstances, when but moderately swollen, produce stenosis of one or the other bronchus ; and even the lower end of the trachea, immediately at the point of bifurcation, may be compressed by such enlarged glands. Thus Alken[1] narrates a case, in a girl four years of age, with tuberculosis of the bronchial glands, in which there were nightly paroxysms of suffocation. The largest gland, which had acquired nearly the circumference of a hen's egg, so compressed the trachea, at the point of bifurcation, that its calibre was diminished to about one-third of its former size. According to Demme's[2] collection of cases of stenosis due to goitre, the swelling of the tracheal and bronchial glands is a not infrequent complication of struma.

Suppuration of the glands mentioned, with perforation of

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[1] Schmidt's Jahrb., 1840, 28, Bd., p. 61.

[2] Ueber Stenose der Trachea durch Compression, nebst Bemerkungen über Tracheostenosis im Allgemeinen, Würzburger med. Zeitschr., II. Bd., 5. u. 6. Heft, p. 390.

the abscess into the trachea or a bronchus, is to be mentioned
as a very infrequent termination. Cases of the kind have been
narrated by Frazer,[1] Edwards,[2] Graham Tice,[3] Weil,[4] and others.

Aneurism of the aorta is a cause of stenosis of the larger air-
passages not less frequent than swelling of the glands. Accord-
ing to Rokitansky, it is principally *aneurisms proceeding from
the concavity or the posterior circumference of the arch of the
aorta,* which lead to compression of the trachea and primitive
bronchi. There are also, however, cases of compression of the
right bronchus by aneurism of the ascending aorta, and of the
trachea by aneurism of the innominate artery. The biblio-
graphy of aortic aneurisms contains numerous cases of this kind
of stenosis, yet it should be borne in mind that every case of
dyspnœa observed in patients with these aneurisms is not to be
attributed to compression of the trachea or of a bronchus. On
the other hand, pressure upon the left recurrent nerve, which,
as is well known, is not infrequently paralyzed by aneurisms
of the aorta, is hardly competent to produce real dyspnœa.
Although such a unilateral paralysis of the recurrent produces
an alteration of the voice to which the older pathologists gave the
inappropriate name of "vox anserina," the cause of which was
first laryngoscopically demonstrated by Traube[5] to be a paraly-
sis of the left vocal cord, shown by its taking the cadaveric
position, nevertheless the constriction of the glottis thus pro-
duced is hardly sufficient to occasion any severe manifestations
of dyspnœa. The cadaveric position of the vocal cord thus
produced, associated with failure of the movements to and fro,
diminishes the glottis, at the most, but one-fourth of its normal
dimensions. Very mild grades of this dyspnœa may, therefore,
perhaps be confounded with that occasioned by moderate com-
pression of the trachea. The differentiation of the two forms

[1] Edinburgh Monthly Journ., VIII., Jan., 1848.

[2] Med. Chir. Trans., Vol. 37, 1854.

[3] Ibidem, Vol. 26, 1843.

[4] Fälle von Tracheo- und Bronchostenose, Deutsches Archiv für klinische Medicin,
Bd. XIV., p. 82.

[5] Deutsche Klinik, 1860, No. 41.

is of course based upon the alteration in the voice, and especially upon laryngoscopic examination.

Diseases of the mediastinum, mediastinitis, and especially mediastinal tumors, are to be mentioned as further causes of tracheal and bronchial stenosis. Mediastinal tumors which occur most frequently in the form of sarcoma or carcinoma, less frequently in the form of lipoma and fibroma, implicate in their subsequent course the contiguous organs also, especially the pericardium and the pleura, and when very large they may compress the different organs of the thoracic cavity, especially the trachea or bronchi. According to the seat and extent of the tumor it will compress sometimes the trachea, sometimes the point of bifurcation, sometimes again but one bronchus. Such a case of mediastinal tumor, in which the tracheal stenosis occasioned by it had been diagnosticated by the aid of the laryngoscope during the life of the patient, has been described by myself.[1] A similar case has also been reported by Pastau.[2] A careful compilation of the cases recorded has led me to the conclusion that tracheal stenosis in mediastinal tumors is one of the infrequent sequences. More frequently there is compression of one or the other primitive bronchus, or of some of its branches, with correspondingly increased activity of respiration in the other lung, and diminution of the expansibility of the affected side. The compression of the trachea, moreover, when it does occur, ordinarily is not very great.

In like manner with mediastinal tumors, may the very rare affection, *mediastinal abscess,* lead to compression of the trachea or the bronchi. The same may be said of hemorrhages, of abscesses, situated in the vicinity of the trachea or the bronchi, and having originated in the connective and cellular tissue surrounding the trachea or the bronchi. A case of the latter kind has been reported by Petrunti,[3] and a second, apparently of the

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[1] *Riegel,* Zur Pathologie und Diagnose der Mediastinaltumoren, Virchow's Archiv, Bd. XLIX., Heft 2, p. 193.

[2] Fibrom im Mediastinum anticum mit Compression der Trachea, Art. anonyma und Vena cava sup. ; Thrombose der Vena cava sup. ; Untergang des Nerv. recurrens dexter in der Geschwulst., Virchow's Archiv, Bd. 34, p. 236.

[3] Filiatre sebez., 1838, Schmidt's Jahrb., 25. Bd., 1840.

same character, by Türck.[1]   So also even diseases of the *pericardium, extensive pericardial exudation*, particularly *dilatation of the left auricle*, may occasion manifestations of compression, especially of the left bronchus.   King[2] reports a case of this kind in which the left bronchus was compressed in consequence of dilatation of the left auricle, and Friedreich[3] has reported a similar case.

Tumors of the thymus gland appear very rarely to occasion tracheal stenosis, but usually to implicate principally the vascular and nervous trunks by compression. Congenital cystic hygromas, likewise, on account of their superficial supra-muscular position, rarely exercise pressure upon the more deeply lying structures of the neck.   Cases of compression of the trachea, by the sinking of the cystic lobes between the sternum and the vertebræ, have been recorded by Wulzer[4] and Hawkins[5] (Demme).

Finally, cases have also been known in which *diseases of the sternum, the clavicle, and the vertebral column have occasioned stenosis of the trachea.*   Demme[6] especially has reported cases of this kind.   Stenosis by compression has also been produced by escape of air into the surrounding connective tissue.   Demme mentions especially emphysematous tumors, which after wounds of a bronchus, rise along the trachea and compress the windpipe, chiefly in the region of the interclavicular notch of the sternum—the so-called air-goitres described by the older authors, which are observed as a consequence of wounds of the windpipe, after severe crying, vomiting, etc.

Tumors of the œsophagus likewise occasion compression of the trachea in rare instances.

Biermer[7] mentions finally *cancer of the lung.*   This disease, according to Biermer, is not only associated with closure of

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[1] Klinik der Krankheiten des Kehlkopfs und der Luftröhre.   Wien, 1866.

[2] Guy's Hospital Reports, No. VI.

[3] Virchow's Handbuch der speciellen Pathologie u. Therapie, V. Bd., 2. Abth., p. 236.

[4] Casper's Wochenschr. f. d. g. H. 1836, No. 17, p. 257.

[5] Ibidem, p. 236.

[6] Würzburger med. Zeitschr., 1861–62, 2. und 3. Bd.

[7] Bronchialkrankheiten in Virchow's Handbuch der speciellen Pathologie u. Therapie, V. Bd., 1 Abth., p. 772.

the small bronchial tubes, but also compresses the large bronchi, as he himself observed in two instances.

We mentioned at the beginning, as a *second cause of stenosis* of the larger air-passages, those forms in which the source of injury is *internal*, that is to say, is due to *alterations in the tracheal and bronchial walls*. Such stenoses occur in three ways: 1st, from cicatrices, callosities, and adhesions; 2d, from morbid growths; 3d, from inflammatory thickening of the walls.

With regard to the cause first mentioned, cicatricial contractions of the trachea and larger bronchi are most frequently of syphilitic origin. The syphilitic process, as is well known, has the peculiarity in its severer forms, that the cicatrization following the ulcerations to which it gives rise usually leads to great contraction. This, which is true of the trachea and the bronchi, is likewise true of the larynx. Here, not infrequently, we can see strongly constricting cicatrices proceed from such ulcerative bases, so that considerable disturbance of function is thereby occasioned. The cicatrices thus produced usually consist of ridge-like projecting bands of connective tissue. In many cases these cicatricial cords can be seen extending over large tracts of the air-passages. In others we see near them ulcers not yet entirely cicatrized. Such cases of syphilitic stenosis of the larger air-passages are rather numerous in medical literature. On the other hand, cicatricial narrowing of the trachea and the larger bronchi of other than specific origin is extremely rare. The case therefore observed by Demarquay,[1] in which a stenosis of the trachea appears to have been occasioned by a chronic glanders ulcer, must be regarded as an exceptional rarity.

Catarrhal ulcers never lead to cicatricial narrowing of the trachea and bronchi. On the other hand, it is exceptionally observed after diphtheritic, tuberculous, and typhoid ulcers; examples of which are narrated by Demme.

While, as is well known, morbid growths are by no means rare in the larynx, they are very seldom observed in the trachea or in the larger bronchi. They are observed in the larger bron-

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[1] *Uyr*, Anatom. pathol. des rétrécissements de la trachée.   Paris, 1866.

chi still less frequently than in the trachea. Those which have
been observed are chiefly *polyps, fibromas, carcinomas,* and *epi-
theliomas.* Carcinomas most often affect the air-passages sec-
ondarily. Most frequently their point of origin is in the œso-
phagus or in the thyroid gland,—from whence the air-passage is
secondarily implicated ; manifestations of stenosis being gradu-
ally produced after the growths have acquired a certain bulk.

Cancerous infiltrations of the bronchial walls and polypoid
excrescences of a sarcomatous nature have produced stenosis of
the bronchi in very rare cases only. Biermer cites a specimen
of the latter kind in the Würzburg collection, which had already
been mentioned by Virchow.[1] Numerous sarcomatous nodules
were disseminated throughout both lungs ; and the bronchi,
in several places, were obstructed by polypoid sarcomas which
had grown out from their walls.

According to Förster, primary cancer of the trachea and
bronchi has not yet been observed. Rokitansky describes a
cancerous formation extending from a bronchial stem to its
branches, by which the walls of the bronchi were thickened,
rendered rigid, and diminished in their calibre, and their inner
surface made uneven. He remarks, however, that carcinoma of
the bronchial glands and extensive carcinoma of the costal
pleura were present, and that the disease in question probably
proceeded from these. So, likewise, the cases of carcinoma of
the trachea, reported by Türck, were only secondary cancers.
On the other hand, the case recently reported by Langhans[2]
shows that the bronchi and trachea may serve as a point of ori-
gin for primary cancer. This case, therefore, is not only of
interest because it is the only one of primary cancer of the tra-
cheal and bronchial wall, demonstrated to a certainty, but
because it reveals with certainty the mucous glands as the point
of origin of the entire cancerous formation.

We have designated *inflammatory thickening of the walls
as a third cause of intra-tracheal and intra-bronchial stenosis.*
In general these stenoses from *hypertrophy of the walls* are
exceedingly rare ; but a few well-assured cases are on record.

[1] Verhandlungen d. phys. med. Ges. zu Würzburg, Bd. VII., p. 207.
[2] Primärer Krebs der Trachea und Bronchien, Virchow's Archiv, Bd. LIII., p. 470.

Thus Andral (l. c.) relates a case of chronic bronchitis, without further pulmonary complication, in which the principal bronchial tube of the right upper lobe was so constricted from thickening of its walls that a fine probe could hardly be passed through it. Cyr [1] also mentions similar observations by Demarquay. Gintrac, [2] likewise, mentions a case. At all events these stenoses, at least in their higher grades, are among the greatest rarities.

Finally, we have to mention *acute œdema* of the tracheal and bronchial mucous membrane, which has been especially observed after the inhalation of chemical vapors, after *perichondritic processes, abscess*, and *necrosis of the cartilages*. The latter disease, as is well known, is observed much more frequently in the larynx than in the trachea.

Anatomical Alterations.

The anatomical alterations produced by stenoses of the trachea and larger bronchi vary very considerably, according to the duration and nature of the process. Thus there are a great number of stenoses in which the anatomical examination shows no further alteration than *a more or less marked indentation of the walls*. This likewise applies to a series of *stenoses from compression*, especially when they have existed but a short time. In other cases, on the contrary, especially in those of long-continued compression, there is a series of further alterations. Thus Demme frequently found *hypertrophy of the mucous glands and submucous connective tissue of the trachea*, in the neighborhood of places in the windpipe compressed by goitre. In addition to this he found the pachydermia described by Virchow as existing in the laryngeal mucous membrane, a condition which is characterized by a fissured and scab-like surface of the mucous membrane, and is dependent upon hyperplasia of the epithelial layer. While the thickening of the submucous connective tissue reached a high grade in several cases, he never found the muscular layer hypertrophied, though the perichondrium often was.

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[1] Des rétrécissements de la trachée. Thèse. Paris, 1866.

[2] Bull. méd. de Bordeaux, Juin, 1844.

Further, Demme found the cartilage atrophied in most instances, as a result of the compression of the trachea. He even found it rarefied in cases in which the remaining coverings were still perfectly healthy. Sometimes there is even complete absorption of the walls, so that a rupture of the trachea ensues. Thus Paget has reported a case in which a cyst of the thyroid gland, after producing gradual absorption and atrophy of the walls of the pharynx and trachea, discharged its contents into these cavities, and thus caused death by suffocation. Similar cases have been reported by Lieutaud, Gooch, Demme, and others.

The form of the stenosis, as shown by Bonnet and Demme, may vary extremely; it depends chiefly upon the anatomical relations of the parts and the consecutive alterations in the tissue of the walls. Thus compression from before backwards will make it a transverse slit. If the surfaces pressed upon are narrow, it may happen that the walls of the windpipe will be in contact only in the middle, thus leaving more or less irregular prismatic spaces of variable size arranged anteriorly and posteriorly. In other cases the contracted part acquires the form of a triangle with its acute angle directed forwards. Circular stenoses occur very rarely as the result of pressure (Türck).

The anatomical alterations of the second group of cases, *intratracheal and intrabronchial stenoses*, likewise vary extremely. As already stated, syphilis is much the most frequent cause of those stenoses produced by callosities and the formation of cicatrices. In reference to the special alterations occurring in these cases, the reader is especially referred to the excellent article of Gerhardt.[1]

Disregarding the milder forms, such as those produced by condylomas of the tracheal wall (Seidel[2]), small superficial ulcers and the like, we should next take into consideration well-defined *syphiloma of the trachea and bronchi*. This, according to Gerhardt, very seldom occurs in the form of projecting circumscribed nodules, but usually in the form of a diffuse thickening of the entire tracheal wall, often covered internally with

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[1] Deutsches Archiv f. klin. Medicin, Bd. II., p. 535.
[2] Jenaische Zeitschrift, II., 4.

papillæ, folds and ridges, which present the characters of syphiloma described by Wagner.[1] There is also frequently an ulcerative process on the surface of the tracheal wall, which may involve the entire circumference of the internal surface at once or consecutively, producing a circumscribed annular ulcer; or the ulcers may be small, involving but a portion of the circumference. If these ulcers penetrate deeply, they lead to perichondritis, to denudation, ossification, and detachment of the tracheal ring or individual portions of them; so that these are sometimes coughed out in the further progress of the disease, and sometimes become bent, dented, thinned, and pushed over one another (Charnal).[2] Sometimes the purulent liquefaction of the so-called infiltration, beginning in the interior, extends to the perichondrium, or even towards the outside of the trachea (Wallman),[3] and leads to abscesses. After a longer progress the process is then disposed to undergo a retrogressive metamorphosis in such a manner that callous, uneven folds, bands, and projections of cicatricial tissue bulge inwards. At places where cartilage has been destroyed or very much indented, annular strictures form, which not infrequently are so small as hardly to admit the passage of a crow-quill (Gerhardt).

The seat of the disease may be the entire surface of the tracheal wall. This was the case in four out of twenty-two cases analyzed by Gerhardt. In six observations, the uppermost portion of the windpipe was affected, extending usually from just below the cricoid cartilage, down as low as the fifth tracheal ring, at the farthest. In twelve other cases the disease occupied the lower half of the trachea, generally in the region of the bifurcation, so that it often extended into the primitive bronchi. The bronchi were affected in three cases out of four of disease of the entire trachea, in six out of twelve of disease of the lower end, and not at all in six of disease of the upper portion of the windpipe. In all the cases of disease of the entire windpipe the larynx was at the same time narrowed.

Morbid growths form a second intratracheal and intra-

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[1] Archiv der Heilkunde, IV., 222.

[2] Notes from Vigla's clinique (Gaz. des hôp., 1859, 21, Schmidt's Jahrb., CII., 100.)

[3] Virchow's Archiv, Bd. XIV., p. 201.

bronchial cause of stenosis.   In general, morbid growths are observed in the trachea and bronchi much less frequently than in the larynx.   The forms observed are, on the whole, similar to those which occur in the larynx, so that a special description of them seems to be unnecessary.

Inflammatory thickening of the tracheal and bronchial walls constitutes a final cause of stenosis.   This thickening may extend over a greater or smaller portion of these structures, sometimes affecting the different tissues uniformly, sometimes only certain of them.   On the whole, such inflammatory thickenings leading to manifestations of stenosis are very rare.

Wilks[1] has reported a couple of cases of the kind.   A case reported by Gibb, in which tracheotomy was performed on account of dyspnœa, appears to have been one of hypertrophy in consequence of chronic inflammation of the mucous membrane and the deeper strata.   The trachea was narrowed longitudinally by very great thickening of its walls.

Similar stenoses of the bronchi, due to thickenings of the bronchial walls from chronic inflammation, have been but very rarely observed.   A case of the kind has been related by Andral.[2] The main bronchus of the upper lobe of the right lung was so constricted from thickening of its walls, that it was barely possible to introduce a delicate stylet.   The submucous tissues were unaltered, but the mucous membrane was much thickened and reddened.

On the whole, this last-mentioned form is of extreme rarity. Though chronic inflammatory thickenings of the walls of the bronchial ramifications are not infrequently observed, they seldom acquire such dimensions as to produce any considerable narrowing of the calibre of the tubes.

As to the *anatomical consequences* of such stenoses, we have first to mention a *dilatation of the bronchial twigs below the point of stenosis.*   This is absent only in rare cases, and then especially when the stenosis is so considerable and severe that respiration is entirely or almost entirely cut off from the corresponding section of the lung.

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[1] Guy's Hosp. Reports, 1863.

[2] Clinique med., 3 Edit., T. III., 1834.

The occurrence of this secondary bronchiectasis is chiefly favored by the severe and frequent cough. In the same manner an abundant bronchial secretion favors the occurrence of secondary bronchiectasis, inasmuch as the stenosis prevents the escape of the bronchial secretion, or at least impedes it to a very great degree. In addition to this, emphysematous expansion of individual sections of the lung is not infrequently observed as a direct result of the stenosis. In other cases, again, there are atelectatic portions of the lung. That catarrh, sometimes of the minuter, sometimes of the coarser bronchi, not infrequently exists in connection with the stenosis, requires no special mention. The same may be said of the terminal pneumonia, not infrequently observed in these cases.

Symptomatology.

In describing the symptoms of tracheal and bronchial stenosis, we may be brief, since a separate description of the different forms mentioned appears unnecessary. The symptomatology, as far as it has reference to the *stenosis*, is exactly the same whether it is due to pressure externally, or whether the cause of the contraction lies within the trachea or the bronchi. Only the *degree of stenosis* has any special influence upon the train of symptoms. The symptoms observed in tracheal and bronchial stenosis are therefore only in part due to the stenosis, the remaining part belonging to the fundamental disease which has given occasion to the stenosis. The symptoms belonging to the latter category may exhibit the utmost variety corresponding to the great variation of these causes, while the more restricted symptoms occasioned by the stenosis itself always exhibit a certain identity. We have to do only with the latter in this article.

It is evident that according to the seat of the stenosis in the trachea or in one or the other bronchus, the symptoms, although corresponding in many points, differ not inconsiderably in others; for which reason a partly separate description of the symptoms of both varieties seems necessary.

Wherever an essential obstacle to the passage of air exists

at any point of the larger air-passages, the type of breathing
exhibits alterations.   Taking for granted that the peculiarities
of the type of breathing in normal respiration are well known,
we need only recall that the inspiration is never longer than
the expiration under normal conditions, but usually somewhat
shorter ; [1] that the inspiration always passes into the expiration
without pause, while a pause at the end of expiration, though
not constant, is still observed with tolerable frequency.   In
contradistinction to this type, every constriction of the larger
air-passages (larynx and trachea), let the cause be what it may,
produces a special form of dyspnœa, which we may, following
Biermer and Gerhardt, designate as "inspiratory dyspnœa."

As is seen by mere inspection, but as is better exhibited by
the method of graphic exploration introduced by myself, inspi-
ration chiefly is disturbed in all these cases.   This form of
dyspnœa is therefore readily distinguished from a second form
observed in bronchial asthma, emphysema, and chronic bron-
chial catarrhs.   The latter form of dyspnœa is distinguished
from the other by the designation *expiratory*.   In proportion
to the magnitude of the obstruction the respiration is a forced
one ; and it is self-evident that obstructions which close the
greater portion of the calibre of the trachea lead to a severer
degree of dyspnœa than those which implicate but one primary
bronchus, even when they render it in great part or almost
entirely impervious.   *If the obstruction is situated only in one-
half of the thorax, therefore implicating only one of the primi-
tive bronchi, then, as a matter of course, the altered conditions
are manifested chiefly upon the side of the occluded bronchus.
If, on the other hand, the obstruction is situated in front of the
point of bifurcation, then the results are participated in by
both halves of the thorax.*

Let us consider a case of the latter kind, and select an
instance of great narrowing of the trachea.   The anomalies of
respiratory movements exhibited under such circumstances are
so characteristic that the diagnosis of stenosis of the larger air-
passages can be made from them alone.   Inasmuch, as stated

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[1] For details I refer to my monograph: *Riegel*, Die Athembewegungen.   Eine
physiologisch-pathologische Studie.   Würzburg, 1873.

already, it is chiefly inspiration which is attended with great difficulty, the patient, in order to overcome this obstacle, employs all the muscles which can in any way facilitate the expansion of the thorax. In spite of all this effort, however, he does not succeed in securing the introduction of a sufficient quantity of atmospheric air in the same space of time as under normal conditions, and therefore expends considerably more time in effecting his inspiration ; but nevertheless it is only gradually and with great difficulty that he can expand the thorax, and, as I have demonstrated graphically, the increments of expansion diminish with each additional interval employed in inspiration.[1]

Expiration follows quite easily, and relatively promptly, in pure uncomplicated cases. This is readily comprehended if we consider, on the one hand, the relatively slighter inspiratory expansion, despite considerable exertion of force, and, on the other hand, the sum of the forces set free at the commencement of expiration. In other cases, more or less complicated, on the other hand, expiration also is sometimes impeded, though in a less degree than inspiration. In correspondence with these conditions the inspiratory action of the lower borders of the lungs is diminished or is held altogether in abeyance.

A *relative prolongation of the respiration* must be mentioned as a further peculiarity of stenosis of the larger air-passages. This prolongation is readily explicable because inspiration requires a much longer time than in normal respiration. An analogous symptom is observed, under some circumstances, in diseases in which an obstruction to expiration is involved ; it differs only in this, that a considerably longer time is devoted to the expiration. This symptom can be explained most naturally by the beautiful experiments reported by Breuer.[2] It lies, as demonstrated by Breuer, in the principle of self-regulation of the respiration by the pneumogastric nerve, that the individual respiratory obstructions can be combated by suitable modifications. Insufficient filling of the lungs, therefore, occasions stronger and more continuous inspiratory efforts ; and impeded

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[1] Athembewegungen, l. c.

[2] Die Selbststeuerung der Athmung durch den N. vagus.   Sitzungsber. der k. k. Akad. d. Wissensch. zu Wien., Bd. LVIII., Abth. II., Nov., 1868.

emptying of the lung must strengthen and prolong the expiration.

In spite, however, as above mentioned, of the activity of all the auxiliary muscles of inspiration, and the greater length of time devoted to the phase of inspiration, the respiratory obstacle is in no wise compensated for thereby. In all stenoses of this kind, the breathing presents the peculiarity of the forced costal type. In spite of all exertion, the necessary quantity of air is not drawn in, in consequence of which considerable rarefaction of that in the lungs takes place, which is, of course, most manifest at the points most remote from that of the entrance of the air. Thus it is explicable that *in severe forms of stenosis the most yielding points are drawn inwards with each inspiration.* A retraction of this kind occurs with each inspiration, especially at the lower portion of the sternum and the lowest ribs, and extends the higher upwards the greater the respiratory obstruction. At the same time the intercostal spaces, the jugular and the supraclavicular fossæ sink inwards.

Though hardly of diagnostic value, still the fact, first demonstrated by Demme, is worthy of consideration, viz., that *the circumference of the thorax is diminished in its upper portions as the result of long-continued stenosis of the trachea.* In long-continued stenosis of one bronchus only, the corresponding chest wall sometimes sinks inward, and this sign may be of diagnostic value under some circumstances. Thus Mayne[1] observed a marked retraction of the left wall of the chest in a case of aneurism of the aorta, and based thereon the diagnosis of compression of the left bronchus. I have myself had the opportunity of frequently examining a case minutely, in which there was a bronchial stenosis of the right side, apparently of syphilitic nature. Here there was distinct diminution of the circumference of the affected side ; and, in addition, the difference between the circumference of inspiration and expiration was greatly lessened as compared with the healthy side.

We have to mention, as an important sign with reference to its distinction from laryngostenosis, that *in tracheal stenosis*

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[1] *Stokes*, Dis. of the Heart.

the larynx is but very little or not at all moved up and down in respiration. In laryngostenosis, on the contrary, as is well known, the larynx makes very marked respiratory excursions, in consequence of the pressure of the current of air above and below the point of narowing (Gerhardt).[1]

Furthermore, the stenotic respiratory sounds, the noisy, wheezing breathing, the "cornage," heard in the vicinity of the point of narrowing, are especially characteristic. These sounds are often of such intensity that they may be heard at quite a distance. The expiratory sound is considerably higher in pitch than the inspiratory sound, in contrast to the normal condition (Gerhardt).

Gerhardt calls attention to still another circumstance worthy of consideration. If the attempt is made to discover the seat of this loud respiratory sound, with the stethoscope carried from the larynx to between the shoulder blades, it appears that it is by no means heard most strongly at the place of constriction. Some of the sounds that occur in the trachea can be heard the loudest in the larynx. This is explicable from the complexity of the conditions of transmission of sound.

If the stenosis is located high up in the trachea the wheezing sound can be felt externally as a thrill. In stenosis of one bronchus a distinct thrilling of the chest-wall can be frequently felt on the side of the stenosis, both in inspiration and in expiration, corresponding to the more or less deep humming heard on auscultation.

The voice in tracheal stenosis is frequently faint, weak, muffled, and of limited intensity, corresponding to the weakness of the current of air that strikes the vocal cords.

The vesicular respiratory murmur is no longer audible in severe cases of tracheal stenosis. Sometimes it is considerably diminished and weakened, sometimes it is overpowered by the stenotic respiratory sounds above mentioned. If the seat of the stenosis is in one bronchus, the vesicular murmur of the half of the thorax supplied by this bronchus is feebler or entirely absent. At the same time the respiratory movements of this

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[1] Lehrbuch der Auscultation und Percussion, von Dr. C. Gerhardt, Zweite vermehrte und verbesserte Auflage. Tübingen, 1871, p. 219.

side are weaker, and sometimes, after long continuance, even the thoracic circumference of this side is diminished.

Exploration with the sound, which was at one time more frequently practised, is very annoying to the patient, and not without danger, for which reason it has been given up at the present time.

Exploration with the laryngoscopic mirror, on the other hand, is of the greatest significance. Laryngoscopic examination is not only of great importance, owing to the fact that it establishes with certainty the intact condition of the larynx in cases of tracheal stenosis, in which it cannot be otherwise decided whether the larynx or the trachea is the seat of the stenosis, but also because it often enables us to fully determine the special seat and the nature of the obstruction in the trachea. As a matter of course, examination of the trachea presents somewhat more difficulty than examination of the larynx; nevertheless it is practicable, in by far the greater number of cases, to render the calibre of the trachea accessible to the eye, if the position of the head is but so arranged that a sufficiently broad rectilinear passage is maintained for the rays of light to pass through the larynx and the entire trachea as far as to the commencement of the bronchi.[1]

While, therefore, examination with the laryngoscope is of very great importance in tracheal stenosis, inasmuch as it demonstrates the exact seat and nature of the constriction, the diagnosis of *bronchial stenosis* is principally based upon the following facts: *Diminution of the thoracic movements of the affected side; absence or enfeeblement of the respiratory murmur of this side, with conservation of the full and clear sound on percussion; wheezing, whistling, humming sounds audible at a distance, to which corresponds a palpable thrilling of the thoracic wall of the affected side both in inspiration and expiration* (Friedreich,[2] Weil[3]). The examination of the *vocal fremitus* has been frequently neglected in the diseases under considera-

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[1] Concerning the details of this method, we refer the reader to the instructions given by *Türck* in his excellent treatise on diseases of the larynx and the trachea.

[2] *Friedreich*, Herzkrankheiten, in Virchow's specieller Pathologie und Therapie, V. Bd., 2 Abth.

[3] Deutsches Arch. f. klin. Medicin, Bd. XIV., p. 82.

tion. Nevertheless it is naturally to be expected that the pectoral fremitus of the side affected should be diminished in cases of bronchial stenosis.

In contrast with the diseased side, the half of the thorax, the main bronchus of which is intact, is immoderately burdened; and therefore one may frequently observe, often even after but a short continuance of the stenosis, a not inconsiderable expansion, increased respiratory movements, and depressed position of the half of the diaphragm of this side; in short, the signs of acute dilatation of the lung.

The increased labor thrown upon the healthy half of the thorax, on account of the sudden abolition of the function of the other half, is analogous to what is observed in other affections. Thus, in simple pneumonia we not infrequently see the contiguous intact portions of the lung become dilated. And similarly, in chronic catarrh of the lower portion of the lung, we see the upper portion immoderately overburdened, and thus even an actual emphysema of this portion gradually produced. This secondary dilatation of the healthy portion of the lung occurs on all sides, in every sort of obstruction, with such regularity, that from its seat we are enabled to form an approximate opinion as to the seat of the respiratory obstacle. That its occurrence is more or less dependent upon the yielding nature of the thorax is evident from the rapid appearance of the manifestations and the like. The same reason accounts, also, for the entire absence of this secondary acute dilatation of the lung in certain cases.

The above-mentioned train of symptoms is so characteristic of stenosis of the primitive bronchus of one side, that the diagnosis can always be made from it with certainty. The same is true of stenoses and obstructions occasioned by the presence of a foreign body.

Concerning the aspect of the patient it is still to be mentioned that in the majority of cases the face presents an anxious and pale livid appearance. The pulse is often accelerated. In a case of stenosis of the trachea by compression, recently reported by Weil,[1] in which the vagus was compressed at the same time, the

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[1] Deutsches Archiv f. klin. Medicin, Bd. XIV.

pulse exceeded two hundred beats in the minute. In cases of considerable stenosis, a remarkable smallness of the pulse is observed, as a rule, even within a short period.

The temperature of the body exhibits no important variation as a direct consequence of the stenosis. Where any such variation exists it is usually associated with the fundamental disease which has occasioned the stenosis, or with secondary affections.

The subjective disturbances vary according to the severity of the stenotic manifestations, on the one hand, and the individuality of the patient on the other. Complaints of a feeling of oppression, or of pressure on the chest, are frequent enough. The patient is very rarely able to designate the seat of the affection, as did a patient of Andral, in whom the primitive bronchus of one side was narrowed, who pertinently remarked that he felt as if he breathed with one lung only.

Cough is not occasioned by the stenosis as such, unless there are further causes which give rise to paroxysms of cough. Quite frequently, however, the same process which has occasioned the stenosis gives rise to paroxysms of cough also. In like manner there is no general rule as to the expectoration which sometimes attends the cough.

The further course of the stenotic manifestations is subject to manifold fluctuations. Not infrequently the disturbances occasioned by the stenosis itself are temporarily interrupted by *paroxysms of severe dyspnœa*. These paroxysms of severe dyspnœa, which are associated with noisy respiration, are most frequently due to acute swelling of the mucous membrane and increased deposit of mucus at the place of constriction. Such sudden paroxysms of intense dyspnœa can only be exceptionally traced to sudden increase of the actual cause of the narrowing, as the sudden dilatation of an aneurismal sac, and the like. Perhaps bronchial asthmatic paroxysms may be the cause of this suddenly increased dyspnœa in many cases. The onset of spasm of the larynx, too, may readily increase the dyspnœa to a very considerable degree.

On the other hand, *paralysis of the glottis*, supposed by many to be the cause of these paroxysms, can hardly be so considered with any plausibility. Simple paralysis of the glottis, in the

form of complete bilateral paralysis of the vocal cords, produces no special dyspnœa, at least in the state of rest. Bilateral paralysis of the dilators of the glottis, on the contrary is, as a matter of course, always associated with severe dyspnœa. Apart, however, from the rarity of this affection (there are as yet but three well-established cases on record, one by Gerhardt,[1] one of my own,[2] and a third by Pentzold[3]), it is hardly probable that the dilators of the glottis only should be suddenly paralyzed.

Apart from these paroxysms, which are not in direct connection with the fundamental disease, tracheal stenosis in its ordinary course may be divided into different periods. Gerhardt, who first accurately described these differences, recognized three periods. The first one is almost entirely free from disturbances ; in it, at most, labored respiration occurs only on physical exertion. The second is a stage of continuous and well-marked stenosis, which may extend over a great length of time, and which presents almost all the symptoms occurring in stenosis of the larynx, especially the audible respiratory sounds, the form of respiration, and its relative prolongation. The voice of the patient is weak in this stage, and of limited volume, on account of the feebleness of the current of air which strikes the vocal cords.

The third stage, according to Gerhardt, is apt to appear very rapidly. It commences with a paroxysm of suffocation, which soon passes over, and from which the patient apparently recovers. Nevertheless the paroxysm recurs after a shorter or longer interval, and the patient either dies in the paroxysm, or succumbs consecutively to a rapidly extending pneumonia of aspiration.

Although every case of tracheal stenosis by no means passes through the three stages mentioned, in the order we have given, still this may be regarded as the normal course in the majority of cases.

The importance of the affections under consideration renders it justifiable to contrast the clinical train of symptoms, briefly, with those manifestations which are

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[1] Virchow's Archiv, Bd. XXVII., p. 298.

[2] Berlin. klin. Woch., 1872, Nos. 20, 21, 1873, No. 7.

[3] Deutsches Archiv f. klin. Medicin, Bd. XIII., Hft. 1. u. 2.

observed in *artificial constriction of the trachea in animals.* Biermer, in his excellent essay on bronchial diseases, has already related some experiments on animals made by Fick and himself. I have frequently performed such experiments, even in my lectures; but employ another, and, as it appears to me, more suitable method. Biermer, in his experiments upon animals, either kept the nostrils closed, or compressed the trachea with the finger. My experiments, on the contrary, in which, at the same time, I desired to represent the breathing graphically, were performed in such a manner that after preliminary tracheotomy an ordinary tracheal canula was introduced, to which a tube was attached terminating in two limbs. One of the limbs of this tube was placed in communication with a rubber tube leading to the cardiograph, and the other was allowed to remain open. On this open limb, which carried a rubber tube at its end, an entire series of tubes of different calibres were placed one after another. The cardiograph was in connection with the rotating drum of a kymograph, and thus, without touching the animal in the least, the alterations of respiration following the different calibre given to the windpipe, according to the size of the glass tube inserted, were accurately represented graphically.

It was thus shown that in proportion as the larger air-passages were constricted, there was an increasing prolongation of the breathing. At the same time the curve was the longer the slower the breathing, that is, the more the air-passage was constricted. The increasing slowness of the breathing, and the increasing size of the curve corresponded completely; so that with every further increase in the constriction of the tracheal tube, both became altered in the same way, and at the same rate.

The remaining manifestations, such as the employment of all the auxiliary forces, loud, whistling respiration, increase in the number of pulsations, and the like, require no further description. In all important points the results of these experiments with animals coincide with the clinical symptoms.

The symptoms described in the preceding pages relate only to what is directly occasioned by the tracheal and bronchial stenosis. In the majority of cases there are, in addition, a series of further symptoms, which belong to the fundamental disease that has produced the stenosis. These, as a matter of course, vary according to that disease. Concerning these symptoms, which belong to goitre especially, to mediastinal tumors, aneurism of the aorta, syphilis, in short to all the affections previously mentioned in the article on etiology, the reader is referred to the appropriate chapters.

The same remark applies to the symptoms of the conditions consecutive to the stenosis. These concern chiefly the organs of respiration and circulation, especially emphysematous distention of individual portions of the lungs, secondary pneumo-

nia, bronchiectasis, dilatation of the heart, and the like. A special description of them is not requisite in this place.

Diagnosis.

In establishing the diagnosis of a tracheal or bronchial stenosis, it is essential in the first place to determine the existence of a narrowing of the larger air-passages; and secondly, to determine the special seat and nature of the stenosis.

The first point, *the determination of the existence of a narrowing of the larger air-passages*, should, with the help of the points above discussed, present no special difficulty. The points of especial importance are: relatively prolonged and extremely difficult breathing; the predominant inspiratory dyspnœa, at least in tracheal stenosis, with the special characters already mentioned; the epigastric retraction; the absence or feebleness of the respiratory murmur, with relatively full and clear pulmonary resonance; the stridor; the slight or negative impairment of the voice; the gradual occurrence and increase of the stenotic manifestations; the knowledge of the fundamental disease occasioning the stenosis; and so on.

On the other hand, the distinction between tracheal stenosis and laryngeal stenosis presents some difficulties, at least in some cases. It is not so much here the acute affections of the larynx, such as croup, œdema, and spasm, which can give rise to mistake, as certain more insidious anomalies of the larynx occurring at the same time.

We have to consider, first, the signs previously mentioned as especially insisted on by Gerhardt. In tracheal stenosis the larynx, as a whole, moves but slightly up and down during breathing, or not at all. In laryngeal stenosis it makes very marked respiratory excursions. In spasmodic respiration and noisy breathing, slight respiratory movement of the larynx, not exceeding one centimetre, is a certain sign of tracheo- or tracheo-bronchio-stenosis (Gerhardt).

A differential diagnostic sign of tracheal stenosis, as distinguished from laryngeal stenosis, is evinced, as shown by Gerhardt, in the position of the head. In most laryngeal stenoses,

and particularly in those which affect the glottis, there is a bending of the head backwards, which is not observed in tracheal stenosis. In pure tracheal stenosis, on the contrary, there is a somewhat protruded and slightly depressed position of the chin.

With regard to the employment of the sound as a diagnostic means of distinguishing laryngeal from tracheal stenosis, this instrument, as previously observed, is to be discarded. Laryngoscopy, on the other hand, is always competent to distinguish with certainty laryngeal from tracheal stenosis.

Special mention must be made of one laryngeal affection, which may readily lead to a mistake, despite examination with the mirror, on account of its apparently negative result, and that is, bilateral paralysis of the posterior crico-arytenoid muscles. While the forms of paralysis of the vocal cords ordinarily observed, and complete bilateral paralysis of the recurrent nerve, produce little or no dyspnœa, but always alteration of the voice, bilateral paralysis of the posterior crico-arytenoids leaves the voice intact, but always gives rise to very great dyspnœa. The vocal cords in these cases do not present the usual cadaveric position, as in pure paralysis of the recurrent nerve, but they are approximated so as to leave but a small fissure between them, which becomes further diminished by each inspiration. It is therefore necessary, in order that this form may not be overlooked on account of the entire absence of alteration in the voice, that the vocal cords be examined laryngoscopically, not only during phonation, but also during both quiet and forced inspiration.

Complete paralysis of the recurrent nerve of both sides cannot lead to any mistake, as it always produces absolute aphonia, but never any great difficulty in respiration.

It must not be forgotten, moreover, that tracheal or bronchial stenosis is not infrequently combined with paralysis of the recurrent nerve. This paralysis of the recurrent is usually unilateral, and therefore has no important influence on the dyspnœa. The not infrequent association of tracheal or bronchial stenosis with paralysis of the vocal cords, is readily explicable from the fact that, by pressure and the like, a series of

affections, especially aortic aneurisms, mediastinal tumors, and the like, not infrequently injure the recurrent nerve and the trachea or a bronchus at the same time.

It was stated in our introduction that we would exclude the subject of foreign bodies in the air-passages from the discussion before us. That foreign bodies may give rise to the symptoms of stenosis already mentioned requires no further comment. Their differentiation depends, above all other things, upon the history of the case, which in the majority of cases points with certainty to the penetration of a foreign body. A valuable sign, in many cases, is the movement of the body up and down within the great air-passages. In very rare instances the foreign body, which at first occluded the one bronchus, becomes forced by cough, or other violent movement, from its primary position, and lodges in the other bronchus, or in some other situation.

In the majority of cases the foreign body, as soon as it gets into the air-passage, excites more or less alarming symptoms, and leads to a fatal termination, often in a short time, if it is not soon removed. On the other hand, however, undeniable instances have been known in which foreign bodies have remained in the trachea or in one bronchus for weeks, months, and even several years.

In spite of all the points mentioned, the differentiation of the diseases we are considering from stenosis occasioned by a foreign body, presents considerable difficulty in many cases. This will especially be the case, if, as in an instance recently reported by Hamburger,[1] not only every evidence is wanting as to the entrance of a foreign body, but nearly every local symptom likewise, as convulsive cough, pain in the throat, dyspnœa, cyanosis, and the like.

The diagnosis of bronchial stenosis presents less difficulty than that of tracheal stenosis. The more or less complete inactivity of one lung, with at least not infrequent overaction of the other; the full and clear percussion sound, with absent or enfeebled respiratory murmur; the palpable and audible thrilling of the affected side, its diminished vocal fremitus, and other symptoms of the same nature, readily permit the diagnosis of more or less complete impermeability of one bronchus. On the other hand, the determination whether the case is one of foreign body in a bronchus, or of syphilitic stenosis, or of stenosis from compression, can often be only decided by recalling all the indications above mentioned, especially the recollection as to previous history. In by far the greater number of cases, the special diagnosis presents no difficulty on careful consideration of all the attendant circumstances.

It is still to be mentioned that tracheal stenosis is frequently associated with bronchial stenosis. In these cases only the accurate appreciation of all the attendant circumstances, and especially with the aid of tracheoscopy, can render the diagnosis possible.

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[1] Berl. klin. Woch., 1873, Nos. 28 u. 29.

Finally, the determination of the fundamental disease will also furnish points to help the more special diagnosis.

Duration, Terminations, and Prognosis.

Narrowing of the trachea and bronchi is of very variable duration, according to the cause by which it has been occasioned. The majority of the above-mentioned processes which can give rise to stenosis are of relatively slow progress; consequently the stenotic manifestations developed by these causes will, as a rule, be tolerably protracted. Still, there are also cases in which the complete picture of stenosis is developed in a tolerably rapid manner.

As to the termination, that depends upon the fundamental disease occasioning the stenosis on the one hand, and on the degree of the stenosis on the other.

As many of the fundamental diseases mentioned, such as mediastinal tumors, acute aneurisms, and the like, are incurable and gradually increase more and more, the prognosis in such cases is unfavorable. But independently, also, of these fundamental diseases, a severe grade of stenosis of the trachea or the larger bronchi, even when only one primary bronchus is affected, often leads to a fatal termination. The rapidity with which this ensues is, as a matter of course, very different in different instances. Nevertheless, there are cases of stenosis of the large air-passages which offer the possibility of recovery. Such a possibility exists when the narrowing is not yet very great, and when the source of injury occasioning the stenosis is one which can undergo retrogression; such, for example, as swollen glands, goitre, and the like. On the other hand, severe stenoses of the trachea and the bronchi, which have been occasioned by syphilis, are usually of unfavorable prognosis.

All those cases offer a relatively favorable prognosis in which the stenosis is situated high up in the trachea, and is occasioned by benign tumors pressing on the trachea, or by simple cicatrices; because in such cases tracheotomy is at least competent to avert the direct danger to life.

Those cases also in which benign growths have become devel-

oped in the interior of the trachea frequently present a favorable prognosis ; and the prognosis is the more favorable the higher the location of the morbid growth constricting the windpipe.

The final fatal result takes place gradually, with cerebral manifestations in most instances. Pneumonia and œdema of the lungs are frequent complications shortly before death.

In rare cases the fatal termination takes place suddenly, while as yet the manifestations of dyspnœa have not assumed an alarming character. In cases of rather great stenosis of the trachea and bronchi, the possibility of such a sudden fatal termination must not be lost sight of. It may have its origin in sudden occlusion by mucus or secretion, or in the perforation of abscesses which proceed from contiguous organs, and suddenly rupture into the trachea, or in aortic aneurisms which break through into the trachea or into a bronchus. In some cases the fatal termination has taken place suddenly, and even the autopsy has not disclosed the cause of the sudden death. As a rule, however, it must be borne in mind that death takes place gradually, with manifestations of sopor and coma.

Treatment.

In general, no especial benefit is to be expected from treatment in these affections. The first indication in treatment is to relieve the disease occasioning the stenosis. As, however, the majority of affections occasioning tracheal and bronchial stenosis are incurable, it is not possible to satisfy this indication in most cases.

If the stenosis is occasioned by goitre or swollen glands, the indication is to relieve these conditions. As to the special manner in which this is to be done we refer the reader to the works on surgery. If the operative removal of swollen glands appears unadvisable from any reason, or is no longer possible, the attempt should be made to reduce them by the employment of absorbent remedies, by parenchymatous injection, and the like ; and thus lessen the compression.

Where syphilis is the origin of the stenotic manifestations, the attempt should be made to determine whether an improve-

ment in the symptoms cannot be effected by an antisyphilitic treatment. The iodides are especially indicated in these cases, and, under certain circumstances, subcutaneous injections of corrosive sublimate also. Sometimes an active inunction-cure does great service in these cases. In general, however, no special benefit is to be expected from the procedures mentioned, in such stenoses as are dependent upon syphilis.

There is a series of stenoses, on the other hand, in which, as the causal disease can be in no way relieved or modified, there can be no question of causal treatment. These are the cases due to aneurisms of the aorta, tumors of the mediastinum and the like. In all these cases, and in others also in which the fundamental disease is beyond relief, either tracheotomy alone can save life, or else treatment of symptoms is all that can be attempted. Tracheotomy can be resorted to only in those cases in which the seat of the constriction is high up in the trachea. In bronchial stenosis it is useless as a matter of course, and so even in tracheal stenoses located low down or just above the bifurcation. It is therefore necessary to determine the seat of the stenosis with accuracy before deciding as to the indication for tracheotomy.

In those cases, on the other hand, in which no benefit is to be anticipated from the methods previously mentioned, and in which tracheotomy does not appear to be indicated, the treatment must be purely symptomatic in character. Thus, if there is an abundant accumulation of mucus, and the breathing is more or less impeded, expectorant remedies are indicated, and even emetics under certain circumstances. If there is great swelling in the neighborhood of the stenosis, and the symptoms occasioned by the narrowing appear to be increased thereby, antiphlogistic treatment is indicated; especially the local application of cold, ice compresses, local abstractions of blood, derivatives to the skin, inunctions of stimulating ointments, and the like. In cases of very great dyspnœa, and in cases in which none of the remedies mentioned are called for, sedative remedies are often in place. Finally, stimulants are to be employed in accordance with the general rules for their administration.

FOREIGN BODIES IN THE TRACHEA AND BRONCHI.

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Etiology and Pathogenesis.

The presence of foreign bodies in the trachea and bronchi produces a condition closely resembling the stenosis occasioned by morbid growths and similar causes, so that it seems very proper to speak of the former in immediate connection with the latter. Both kinds of stenoses exhibit a consonant relation in many important points. On the other hand, the train of symptoms, and especially the therapeutic management, of the two conditions differ from each other in so many respects that a separate though brief description of the former seems neces-

sary. Inasmuch as the symptoms due to the presence of a foreign body coincide in their important features with those of tracheal and bronchial stenosis described in the preceding chapter, and also because these affections, with reference to treatment, belong more to the surgeon than to the physician, we shall be very brief in our remarks. We therefore refer the reader to the manuals and treatises on surgery for special details, and especially for details of treatment.

Foreign bodies may gain entrance into the trachea and bronchi in very different manners. The most usual method is that the foreign body gets through the mouth and pharynx into the larynx or the trachea, and thence, according to its size and according also to the existence of certain other determining causes, into a primary bronchus or into smaller bronchi.

The foreign bodies which most frequently gain access from without into the trachea and the bronchi are fragments of bone, the kernels of various fruits, spears of grain, beans, peas, fish-bones, nutshells, small stones, coins, needles, and the like. On the other hand, various normal or pathological products existing in the mouth, pharynx, or larynx, may get into the air-passages: such substances as fragments of the uvula, concretions from the ventricles of Morgagni, fragments of necrosed laryngeal cartilage, teeth, pharyngeal polyps, fragments of a tonsil, pus, blood, and the like. In similar manner, materials from the stomach may get into the air-passages during vomiting: such as thread-worms, chyme, and the like.

In rare instances foreign bodies may gain access into the bronchi and the trachea from a penetrating wound into the lung. Foreign bodies, also, such as pus, bladders of echinococci, and the like, may pass, by perforation, from the pleural cavity, the liver, and other contiguous organs, into the bronchi and the trachea. Usually, in cases of the latter kind, the foreign body is at once entirely or in part discharged again by way of the air-passages.

Foreign bodies, again, such as needles and fishbones, may penetrate from the œsophagus into the trachea or into a bronchus by gradual perforation and the formation of a fistulous track.

The entrance of foreign bodies into the air-passages from
without occurs, in most cases, at a moment in which a deep
inspiration is being taken ; during which, as is well known, the
epiglottis is somewhat raised, and the glottis dilated. It occurs
most frequently during coughing, laughing, sneezing, or speak-
ing.   If the foreign body is at this moment in the posterior por-
tion of the cavity of the mouth, the deep inspiration, which
is associated with the acts mentioned, readily favors the entrance
of the foreign body into the now widely opened glottis.   The
simultaneous occurrence of a deep inspiration and the act of
swallowing especially favors the penetration of the foreign body
into the air-passages.

This accident is most frequently observed in children and in
imbecile patients ; in the latter, chiefly during a meal, but also
during sleep and in conditions of sopor.

In not infrequent cases the foreign body becomes impacted
in the larynx.   This is particularly the case with pointed, sharp-
cornered bodies ; and also in cases in which the size of the
foreign body is such as to prevent its further passage downward.
In other cases—and these are the only ones we shall here take
into consideration—the foreign body passes further downwards
into the trachea, or into a primitive bronchus, or even into one
of the smaller branches.   According to its weight, size, form,
and other qualities, which may have a determining influence in
individual cases, it is retained in one place or the other.
Roundish bodies, without sharp corners and with smooth sur-
faces, do not remain long in the trachea in the majority of cases,
but move further downwards towards the bifurcation or into a
bronchus.

The foreign body passes into the right bronchus more fre-
quently than into the left one.   The latter occurrence, never-
theless, is by no means as infrequent as we might be disposed
to believe from the reports of many authors.   A careful review
of the bibliography shows that a considerable number of cases
are recorded in which foreign bodies have fallen into the left
bronchus.

The more frequent entrance of foreign bodies into the right
bronchus, is sufficiently explained by the greater diameter of

this bronchus.   In addition to this, as indicated by Friedreich,[1] the position of the dividing spur of the two bronchi is directed eccentrically somewhat to the left of the axis of the trachea, so that the larger half of the interior space of the trachea is continuous with the commencing portion of the right bronchus.

The foreign body by no means remains always in the same place.   Even when it has descended into one primitive bronchus, it not infrequently happens that it is repeatedly forced up into the trachea, or even into the larynx, by a vigorous expiration.

On this depends the repeatedly observed fact, that the manifestations of bronchial stenosis, in one and the same patient, are sometimes observed on the right half of the thorax and sometimes on the left.

The foreign body may be coughed out by a powerful expiratory effort, or it may perforate the wall of the air-passage, and thus finally, after a long time, make its way to the exterior. The further course depends principally upon the nature and consistence of the foreign body.   In many cases it may remain in the same place for years without producing any further alterations ; but in other and more frequent cases its long retention produces secondary alterations in the lungs, especially circumscribed inflammation, purulent infiltration, and the like.   Even abscess and gangrene may be caused.

Cases in which the foreign body has remained for years in the air-passages, and which finally recovered perfectly with expulsion of the offending substance, have been observed in numbers. Thus Halmar[2] relates a case in which a bit of bone was not expelled until after fifteen years, and in which complete recovery ensued.

Heyfelder[3] likewise describes an example of spontaneous expulsion of a foreign body from the air-passages after a retention of twelve years.   Andriessen[4] reports a case in which a

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[1] Virchow's specielle Pathologie und Therapie. Krankheiten des Larynx und de Trachea.

[2] London Medical Journal, Vol. VIII.   See, also, *Albers*, Atlas d. pathol. Anatomie und Erläuterungen, 1846.

[3] Sanitätsbericht über das Fürstenthum Hohenzollern-Sigmaringen, 1833.

[4] Casper's Wochenschrift, 1836, No. 48.

grain of corn remained three years in the trachea.   Many similar cases of prolonged retention of foreign bodies within the air-passages are recorded in medical literature.

A case recently reported by Voltolini,[1] in which a nutshell remained for ten months in the trachea of a ten-year old boy, and was finally removed by operative procedure, is of especial interest.   Voltolini justly remarks concerning many similar cases of earlier date, that as they belong to the ante-laryngoscopic period, it was not positively known whether the foreign body was seated in the larynx or in the trachea.   It appears, however, that foreign bodies are more frequently re-tained in the larynx for a long time than in the trachea.

The case reported by Voltolini is of still greater interest, because the foreign body was seen by aid of the speculum through the tracheal wound, after its long retention in the wind-pipe, and was thus diagnosticated with certainty.   Voltolini devised for this purpose a special speculum, similar to Brunton's ear-mirror, which is supplied with a lens.

Anatomical Alterations.

According to the form, volume, and other qualities of the foreign body in the air-passage, according to its situation, and the duration of its retention, the anatomical alterations occa-sioned thereby are different.   It first causes, as a rule, a cir-cumscribed inflammation with great reddening, swelling, and abundant muco-purulent secretion at the place at which it is impacted.   After a while, especially if the surface of the offend-ing body is rough, uneven, and jagged, there is necrosis of the underlying mucous membrane, with purulent, serous infiltra-tion of the immediately surrounding parts, and sometimes even deeply penetrating ulceration.   After retention for a long time, the foreign body may become enclosed in a mass of connective tissue, or even completely covered with a calcareous envelope. In such a condition, when it does not occasion injurious results

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[1] Eine Nussschale 10 Monate in der Luftröhre; ein neues Speculum für letztere; operation, Berl. klin. Wochenschr., 1875, No. 6, p. 81.

by its size or its seat, it may remain in the same place for a long time without giving rise to any other manifestations.

The alterations caused by a foreign body in a bronchus vary in many respects. Here also a circumscribed inflammation is usually developed at the place at which it remains impacted, and this may lead to ulceration and necrosis, often with copious fetid secretion. Almost always, however, anatomical alterations in the lungs are produced when foreign bodies remain a long time in the bronchi. Sometimes these consist in pneumonia, sometimes in the formation of abscess, and less frequently in interstitial inflammation. By suppuration of the surrounding pulmonary tissue, which always extends further and further, the foreign body can come even to the outer surface of the lung, and either make its way into the pleural cavity, or penetrate the chest-wall and thus finally reach the exterior.

When the foreign body completely occludes the calibre of a bronchus, extended atelectasis of the corresponding portion of the lungs is observed in consequence. In rare cases the foreign body has been seen within the parenchyma of the lungs, imbedded in callous cicatricial tissue, or in the cavity of an abscess, enveloped with thickened caseous pus.

Symptomatology.

In describing the manifestations which occur under the influence of a foreign body within the air-passages, a precise separation of the symptoms occasioned by a foreign body within the larynx, and those occasioned by one within the trachea, cannot be well made out. It frequently happens that the foreign body is first retained for some time in the larynx, and then travels further downwards into the trachea and the bronchi. The train of symptoms is therefore frequently ushered in by such manifestations as are occasioned by the penetration of a foreign body into the larynx.

When a foreign body gets into the larynx, the patient, in the majority of cases, immediately experiences a more or less intense suffocative sensation ; violent coughing occurs, as a rule, at once, and in favorable cases expels the foreign body. This is

the case, for example, when small quantities of *fluids* accidentally get into the larynx. Usually these are at once expelled externally through mouth and nose with violent coughing and hawking. If, on the other hand, the quantity of fluid which has fallen into the air-passages is considerable, and only weak and feeble attempts to cough take place, or none at all, as occurs in conditions of sopor, or sometimes in small, feeble children, the patient may even succumb asphyxiated. Cases of this character may be observed, not infrequently, in imbecile patients.

If the body which has fallen into the larynx is *solid*, and if it becomes firmly impacted in the rima glottidis, and fills it up completely, so that little or no air can pass by it, the patient may die at once in the very first suffocative paroxysm. In cases of this kind a paroxysm of cough does not set in, but the patient loses consciousness at once and dies asphyxiated. In other cases, at the very moment in which the foreign body gets into the larynx, a severe paroxysm of suffocation occurs, a spasm of the glottis, the countenance becoming markedly cyanotic, the respiration exceedingly laborious and stridulous, inspiration especially prolonged and difficult, cold sweat breaking out over the brow and the face ; the patient grasps involuntarily towards his throat or his mouth, as if to remove by force the obstruction, the seat of which he correctly recognizes. In favorable cases, the exceedingly violent coughing and gagging succeed after a short time in expelling the foreign body, and then the alarming complication of symptoms ceases at once and entirely, and merely a slight sensation of soreness and irritation in the throat remains for a few days, as the result of the local irritation occasioned by the foreign body.

In other and more frequent cases it happens that the first alarming manifestations subside after a short time, the severe spasm of the glottis ceases, the respiration becomes freer again, and the cyanosis disappears or diminishes in a considerable degree, so that the patient and those around him adopt the erroneous idea that the foreign body has been swallowed or coughed out unobserved. This change of symptoms occurs especially in those cases in which the foreign body has been forced from its primary seat by the coughing, and has fallen

further downwards either into the trachea or into a bronchus. But even in cases in which the foreign body remains in the larynx, the first alarming symptoms may soon subside. According, afterwards, as the foreign body is expelled from the larynx or remains there for a longer time, either all symptoms of disease fade, or an acute laryngitis becomes developed, which may even lead to œdema of the glottis, or pass into the chronic form of the affection.

We refrain from further discussion of the train of symptoms produced by the prolonged retention of a foreign body in the larynx, as foreign to our subject, and pass to the cases in which the foreign body has fallen into the trachea. If the foreign body has entered the trachea, it often happens that it changes its location with the current of air. This mobility may be the cause of another severe suffocative paroxysm, if the body again reaches an unfavorable locality, becomes impacted in the rima glottidis, for example, producing stenosis and exciting spasm. This change of locality may take place repeatedly, and thus the scene sketched above, so alarming to the patient and those about him, may be enacted again and again. Often even a sudden change of position or of posture, or a somewhat more forcible inspiration or expiration, will suffice to occasion a further movement of the foreign body in the trachea. According to the locality in which it then becomes impacted, severe suffocative paroxysms may be occasioned anew, or there may be no further alterations in the symptoms. The patient himself, not altogether infrequently, feels this repeated movement of the foreign body up and down within the large air-passages. In very infrequent cases it is possible to feel distinctly the movement of the foreign body by means of the finger placed upon the windpipe (Allan Burns). In some cases, the stroke of a hard body, or a valvular murmur could be heard through the stethoscope placed in the jugular fossa. These last manifestations fail, as a matter of course, in cases in which the foreign body has bored firmly into some portion of the walls of the trachea. This locomotion of the foreign body during forced respiration, is a very important diagnostic sign for the accurate determination of its position.

As to the remaining symptoms, the cases in which the foreign body has its seat in the trachea are distinguished, in contradistinction to those in which it is located in the larynx, by evidences of much less irritation, provided that it does not lead to severe stenosis by its volume. Corresponding with the lesser sensibility of the tracheal mucous membrane, compared to that of certain portions of the larynx, and the greater calibre of the tube, the paroxysms of cough and the dyspnœa are proportionately less. On the other hand, the symptoms of tracheitis usually occur, to which the symptoms of laryngitis may become added, by the spread of the inflammatory process upon the laryngeal mucous membrane. This will readily occasion deception as to the seat of the foreign body. It is of great importance, however, to remember that the foreign body may constantly get out of the trachea into the larynx again, and thus give rise to extremely severe paroxysms of cough and suffocation. In favorable cases it happens that the foreign body is expelled in one of its journeys towards the glottis. Even when it is certainly known that the foreign body is in the trachea, and when the symptoms apparently are not alarming, the possibility must always be borne in mind that it may become suddenly impacted in the glottis, and thus occasion anew the previously mentioned suffocative train of symptoms.

Severe manifestations of dyspnœa are only occasioned when the foreign body in the trachea is of considerable size, concerning the minuter details of which we refer the reader to the chapter on tracheal stenosis.

As there stated, the most important symptoms of tracheal stenosis are: slow respiration, often with accelerated pulse; a wheezing noise in respiration, often audible at a distance; very prolonged inspiration; diminished, or even abolished movement of the lower borders of the lungs in deep inspiration,—under some circumstances even inspiratory retraction of the thorax at its lowest portion; enfeebled respiratory murmur with full and clear sound on percussion, and the like.

Laryngoscopic examination, though not at once practicable in many cases, is of special importance, because it not only reveals the complete absence of injury to the larynx, but, in

favorable cases, permits the direct inspection of the foreign body.

In many cases the examination with a speculum through the wound in the trachea, after the performance of tracheotomy, is of advantage, as shown in the case recently reported by Voltolini.[1]

If the foreign body has its seat in one of the two primitive bronchi, either after having first lodged in the larynx or the trachea, and then passed into a primitive bronchus, or after falling directly into one of the bronchi, all the manifestations of bronchial stenosis set in.   According as the affected bronchus is wholly or but partially occluded, there will be various modifications of the train of symptoms.

The most important symptoms of bronchial stenosis are the following: diminished inspiratory dilatation of the corresponding half of the thorax, which can be demonstrated both by inspection and palpation, and better still by the comparative graphic method (by means of the double stethograph).   On the other hand, the extent of the movement of the sound side is often increased.   Diminished displacement of the diaphragm, that is to say, of the lower border of the lung on the side of the bronchial stenosis ; smaller circumference of this side in cases of prolonged continuance.   The respiratory murmur is absent, or is considerably enfeebled, while it is frequently exaggerated or puerile on the sound side.   Only where, as in Weil's [2] case, the constriction is slight, will considerable enfeeblement of the respiratory murmur, as compared with that of the sound side, be absent.   The full and clear sound on percussion, which, as all observers admit, differs in nothing from the normal sound, is in marked contrast to the alteration in the respiratory murmur. Sometimes the sound on the healthy side is somewhat more sonorous and deeper, even with a very weak tympanitic sound accompanying it, corresponding to the greater dilatation of this side.   In addition, dull pains are sometimes observed on that side of the chest which is the seat of the foreign body.

To the symptoms mentioned, three others are to be added,

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[1] Berl. klin. Wochenschr., 1875, No. 6, p. 71.

[2] Fälle von Tracheo- und Bronchostenose, Deutsches Archiv für klinische Medicin XIV. Band.

upon which Weil has laid special stress in his recently published essay (l. c.).   The first is a wheezing sound in respiration, which, in the case reported by Weil, was for a long time the only symptom of disease.   It was present both in inspiration and in expiration, and was even audible at a great distance, when the breathing was somewhat forced, while it was weak or audible only in his immediate neighborhood when the patient was at rest.   Its occurrence is to be accounted for in the same manner as the stridor, which is usually observed in stenoses of the air-passages dependent on other causes.

The second symptom observed by Weil is the diminution of the pectoral fremitus upon the side of the broncho-stenosis, a manifestation which is to be expected *à priori* from the impaction of a foreign body in a bronchus.

The third important symptom upon which Weil lays stress is a palpable thrilling of the chest wall of the affected side, on inspiration and expiration, corresponding to an inspiratory and expiratory hum on auscultation.   Friedreich, Gerhardt, Biermer, Demme, and others have long laid stress upon the diagnostic significance of this sound in stenosis of a bronchus due to compression, while it appears not to have been previously observed in cases of foreign body in the air-passages, or but little noticed. Friedreich [1] has especially remarked the diagnostic value of this sign in broncho-stenosis.   In a case observed by him in 1850, and reported in his work on diseases of the heart, a compression of the left bronchus by the dilated auricle, in a young girl affected with marked mitral stenosis and dilatation of the heart, was diagnosticated " by means of a loud humming respiratory murmur, heard over the entire left half of the thorax (and also perceptible to the hand laid upon it) both in inspiration and in expiration, and which, with its greatest intensity on the left side of the cervical vertebræ in the region of the root of the lung, continued to be audible for years, and even up to the time of death."   (The autopsy confirmed the diagnosis.)

This whirring is to be regarded as a stenotic murmur, produced by the passage of air through the constricted portion of the bronchial tube.   Weil compares it to a deep, sonorous rhonchus.

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[1] Virchow's specielle Pathologie und Therapie, V. Band, II. Abtheilung, p. 236.

With reference to the case observed by him, Weil further says that this murmur was readily distinguishable from a rhonchus, because neither inspiration nor coughing exerted any influence upon it; and that it always preserved the same character, and the same intensity, and occupied the same region.

As already stated, it has been frequently observed that a foreign body in a bronchus may suddenly change its position in consequence of a violent fit of coughing, a sudden change of position, or forced expiration, and pass from one primitive bronchus into the opposite one. Under such circumstances the symptoms of bronchial stenosis leave the side first affected, as a matter of course, and appear upon the opposite side.

Atelectasis, or pneumonic infiltration of the affected portion of the lung, often becomes developed subsequently; so that the manifestations of these affections become superadded to those of bronchial stenosis; or it may eventuate in the formation of a pulmonary abscess, and the like.

If the foreign body falls into a narrow bronchus, and occludes it completely, atelectasis, or pneumonic thickening of the corresponding portion of the lung, takes place in most instances. Many of these patients succumb to these secondary affections of the lung. Less frequently the termination is in gangrene or abscess, with perforation externally; or in encapsulization of the foreign body in callous connective tissue within the pulmonary tissue. In several instances perforation has taken place into a large blood-vessel, the occurrence being followed by immediate death.

Course.

As already stated, it not infrequently happens that death occurs at once in persons in whom a foreign body has fallen into the air-passages. On the other hand, however, there are a goodly number of well-authenticated cases, in which foreign bodies have been known to remain in the trachea or in a bronchus for weeks, months, and even years, without any further untoward results. We have already cited cases of this kind on a previous page, and their number could be readily increased.

In seeking the cause why death occurs at once, or very

shortly after the entrance of the foreign body, in some cases, while in others the foreign body may remain a long time in the air-passages without further injury, it appears, as advanced by Hamburger,[1] in his essay on this subject, that the suddenness of the catastrophe is in exact proportion to the completeness with which the entrance of atmospheric air into the lungs, or into a considerable portion thereof, is interfered with. This explains why irregular, sharp-cornered bodies do not kill so quickly as roundish ones, such as beans and peas, which may easily close the calibre of the trachea, or of a bronchus almost entirely; especially as they often swell by imbibition.

In cases of the foreign bodies last mentioned, and others like them, which are capable of swelling, it is often observed that the symptoms are not of an alarming character at first, but that only after a time, as the body swells and increases in size, do the symptoms acquire a more and more alarming character. Cerebral symptoms then soon ensue, either in the place of the local symptoms observed in the first stage alone, or in addition to them. The patient begins to complain of headache; he becomes somnolent; delirium is superadded, even with general convulsions; and finally the fatal termination takes place after complete abolition of consciousness.

In many cases this second stage of cerebral manifestations sets in very early. In others a series of paroxysms, of more or less severe local character, precede the cerebral symptoms for a long time. The number and duration of these paroxysms depend in great part on the size and mobility of the foreign body. In cases of foreign bodies firmly impacted in one place, the number of these paroxysms of local symptoms may be quite inconsiderable, or they may fail entirely (except, of course, the symptoms furnished on physical examination). Thus, in the interesting case reported by Hamburger (l. c.), all local symptoms were absent, so that during its entire course every expression of a local malady was kept completely in the background. It transpired, after recovery, that the patient had choked one

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[1] Diagnose eines fremden Körpers im rechten Bronchus, Klinische Betrachtung dieses Falles, Berl. klin. Woch., 1873, No. 29, p. 340.

day while partaking of a dish of gray peas ; but the symptoms produced thereby were so insignificant, and ceased so promptly that, when the patient became affected with cerebral symptoms, light at first, and more severe afterwards, neither he nor his friends suspected any connection with the swallowing of a foreign body. Still in this case, despite the want of history of a foreign body, and the absence of all local symptoms, except those purely physical, a conclusion could be drawn from the latter alone, as to the existence of a foreign body in a bronchus.

In other cases the course is longer, and here the symptoms of encapsulization, perforation, purulent infiltration, and the like, as the case may be, are frequently, though not always added to the local symptoms already mentioned.

The course is usually accompanied by fever ; especially at the commencement. Only when complications become super-added, pulmonary affections especially, or in consequence of local inflammation and the like, are febrile movements often observed in the further course of the affection.

The duration of the disease may vary within considerable limits. It is self-evident that the duration of the affection can-not be estimated, even approximately, in most cases. There are cases in which the entire process is over within a few minutes, and others in which it is protracted for months and even years.

Diagnosis.

The diagnosis presents no special difficulty in the majority of cases, neither as to the determination in general of the existence of a foreign body in the air-passages, nor as to its precise loca-tion. Accurate physical exploration is of especial importance, and furnishes such characteristic results, especially when the foreign body is in one of the primitive bronchi, that the diagnosis may be established with certainty from this examination alone. In many cases, especially in those in which the foreign body is situated higher up in the trachea, examination with the laryn-goscopic mirror is of great value, as it often serves to determine the exact seat of the foreign body. Examination, too, of the pharynx, and of the œsophagus, may assist in the diagnosis of difficult cases.

The diagnosis is beset with most difficulty in those cases in which the foreign body has fallen into the air-passages unperceived, so that the history does not point to its presence in these passages. Nevertheless, even here, accurate physical examination, combined under certain circumstances with examination by the mirror, will suffice to determine the diagnosis with certainty. Failure to distinguish it from other forms of stenosis is not likely to occur ; but syphilitic tracheal, or bronchial stenoses are the most likely to lead to mistake. Here, the history, the slow development of the symptoms, and the evidence of other residua of syphilis, such as defects of the palate, cicatrices on the epiglottis, total absence of the epiglottis, glandular swellings, and the like, indicate the diagnosis.

Prognosis.

The prognosis is always doubtful. Of course, it is dependent chiefly upon the seat of the foreign body, its size, form, capacity for becoming swollen, and other characters. Even in cases in which the first turbulent manifestations have subsided, the prognosis remains doubtful. In cases in which the foreign body is situated higher up in the trachea the prognosis is more favorable, because the momentary danger may be overcome by tracheotomy, and because the removal of the body may thus be readily accomplished, at least in many cases. In general, pointed objects, with uneven surfaces, offer a less favorable prognosis, because their removal involves greater difficulty. The liability of the body to swell is of influence on the prognosis, inasmuch as that adds to the danger of an increase in the symptoms. But even in cases in which the foreign body is apparently well borne by the organism, the prognosis remains doubtful on account of the dangers to which the patient is exposed through the influence of certain secondary diseases of the parenchyma of the lungs.

Treatment.

The first indication of treatment is, as a matter of course, to remove the foreign body from the air-passages as promptly as possible. Its removal by the finger cannot be accomplished

even in cases in which it is situated high up in the trachea.   On the other hand, one may be tempted to consider the administration of emetics as always indicated.   It is not to be denied that this procedure has in fact rendered important services in many cases.   I need recall here only the case of Hamburger, already cited, in which an emetic certainly saved the life of the patient. Nevertheless, as shown by careful consideration, the employment of emetics entails considerable danger.   Emetics can be used without danger only in those cases in which the foreign body is situated above the glottis or in the chink of the glottis itself.   But it is just in these cases that its removal with the aid of the laryngoscopic mirror is deserving of preference as a much safer method, and one completely devoid of danger.

If the foreign body is located at a lower point, below the chink of the glottis, there is danger that it may become impacted in the glottis during the act of vomiting, and thus occasion a suffocative paroxysm dangerous to life.   Pointed, jagged bodies are the more likely to become impacted in the act of vomiting ; while hard round bodies are more likely to be expelled.

If the administration of an emetic should be decided upon, apomorphine is to be preferred to all other emetics.   The mere fact that it can be administered by the method of subcutaneous injection renders it especially suitable in these cases.   It is followed by prompt action within a few minutes, but is not attended by any unpleasant effects ; facts which thus entitle it to preference over all other emetics.

What has been said of emetics can be said of the method frequently employed in former times of inverting the body of the patient and striking him upon the chest and back in order to facilitate the expulsion of the foreign body.   The danger of impaction is not an imaginary one in such procedures.

In cases in which other methods cannot be employed, nothing remains but to make a careful attempt with the procedures mentioned, especially with emetics.   In general, however, it is advisable not to resort to these procedures, if possible, as they always involve the danger of an impaction of the foreign body in the glottis, and consequently the danger of fatal asphyxia. Where alarming manifestations exist, it is advisable to perform

tracheotomy as early as possible, particularly as it may be con-
sidered as an operation almost devoid of danger when properly
performed upon a subject otherwise healthy. Sometimes, when
a foreign body is deeply situated, it is expelled externally, after
tracheotomy, by the first powerful movement of expiration ; or
it becomes practicable to remove it through the wound with
instruments.

If the foreign body does not come into view at once after
tracheotomy, the success of the operation, as mentioned by
Hueter,[1] should not be doubted on this account ; for many cases
are known in which the foreign body has been coughed out sev-
eral days after the operation. The prognosis is the better,
without doubt, the sooner the foreign body is expelled ; and
thus, from every point of view, the earliest possible performance
of tracheotomy is justified in cases of foreign bodies in the air-
passages (Hueter).

The extraction of a foreign body after tracheotomy often pre-
sents special difficulties. In cases of small foreign bodies which
are impacted in a larger or smaller bronchus, and which are not
coughed out, the attempt should be made to facilitate their
extraction by the so-called aspiratory method. Larger foreign
bodies, on the other hand, even when located at quite a distance
from the wound of tracheotomy, may be reached from the
wound and extracted.

Concerning the special details of this purely surgical treat-
ment, we refer the reader to the manuals and treatises on sur-
gery, especially to Hueter (Tracheotomy and Laryngotomy), in
von Pitha and Billroth's Manual of General and Special Sur-
gery.

The secondary affections of the trachea, bronchi, and lungs
are to be treated on ordinary principles.

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[1] Von Pitha und Billroth's Handb. d. allg. und spec. Chir.

BRONCHIAL ASTHMA.

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Introductory Remarks.

While in the older medical literature the word asthma
was considered as almost identical with dyspnœa, and thus a
series of subdivisions of asthma were recognized in many works
of earlier authors, especially in those of Sauvages, Cullen,
Winter, and others, the profession seemed disposed, in the
period immediately following the discovery of auscultation, to
question the very existence of an idiopathic asthma.   This dis-
position is readily explained by the circumstance that with the
advance in physical diagnosis certain pathological conditions
had to be withdrawn from the "asthma" group of the older
authors, and classed rather among diseases of the heart, of the
lungs, and other organs.

The existence of an idiopathic asthma was first denied by
Rostan, and he was soon sustained by a series of other authors,
as Beau, Louis, and others, who endeavored to bring asthma
into a condition directly dependent upon catarrh, emphysema,
and so forth.   These authors, who denied the existence of a
purely nervous and independent form of asthma, were soon
opposed by a series of capable inquirers, who asserted the exist-
ence of idiopathic asthma, though in a much more restricted
sense than that formerly entertained.   A reliable basis for deter-
mining the existence of asthma could exist, however, only on
physiological grounds; and thus it was chiefly Romberg and
Bergson who first established a sure foundation for the study of
idiopathic asthma.   Since this time the question of the existence
of an independent asthma is to be regarded as decided in the
affirmative; the disputes still pending between different investi-
gators now bearing not so much upon the question of the exist-
ence of this form of spasm, as upon its *seat* and *nature*.

The long-received, but subsequently abandoned theory,—
which, however, has been lately modernized and recently con-
tended for by Biermer[1] with great acuteness—that the essential

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[1] Ueber Bronchialasthma, Sammlung klinischer Vorträge, 1875.

element of asthma is to be found in a spasm of the smaller and smallest bronchi, has been opposed by a number of other theories. This theory of bronchial spasm has been combated with great ingenuity by Wintrich [1] especially, who advances in opposition the theory of a tonic spasm of the diaphragm. While Wintrich maintained the opinion, on the one hand, that a nervous asthma, produced by spasmodic contraction of the smooth muscular fibres in the lungs, is not possible, and does not exist at all as such, he believes the view justifiable that it is caused either by a tonic spasm of the diaphragm alone, or by a spasm of the diaphragm and respiratory muscles together, with which even spasms of the glottis may be associated. In most of the cases of nervous asthma which he had the opportunity of observing himself, he believed that the trouble could be referred to a tonic spasm of the diaphragm. Wintrich's theory was soon supported by Bamberger [2] and Lehmann, [3] both of whom contributed further valuable facts. In opposition to these authors, as already stated, the old idea of bronchial spasm has recently received important support in the admirable essay of Biermer (l. c.).

Asthma has also been regarded as a vaso-motor neurosis ; and Weber, [4] especially, has recently advanced excellent reasons in support of this view. Störck, [5] likewise, has endeavored still more recently to establish the theory that attacks of bronchial asthma are due to acute swelling of the mucous membrane of the bronchioles.

Finally, the interesting facts lately reported by Leyden [6] deserve brief mention. Leyden found in the expectoration of persons suffering from bronchial asthma a mass of elongated octahedral crystals, embedded in a ground substance consisting of

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[1] Virchow's Handbuch der speciellen Pathologie u. Therapie, V. Bd., 1. Abth. Erlangen, 1854.

[2] Würzburger med. Zeitschr., VI. Bd., Heft 1 u. 2.

[3] Biblioth. for Laeger, Bd. 13, 66 pp., 1866.

[4] Tageblatt der 45. Naturforscherversammlung zu Leipzig, 1872, p. 159.

[5] Mittheilungen über Asthma bronchiale und die mechanische Lungenbehandlung. Nebst einem Anhang über den Hustenreiz. Stuttgart, 1875.

[6] Virchow's Archiv, Bd. 54.

cells in the process of granular degeneration. Leyden is disposed to consider the entire complexity of symptoms in bronchial asthma as the effect of these delicate sharp crystals, which produce a mechanical irritation of the mucous membrane of the alveoli and smaller bronchi,—that is, of the terminal filaments of the vagus nerve, with reflex spasm of the muscular substance of the smaller bronchi. We will return to a more detailed discussion of this and other theories.

Our special description of asthma must be premised by the remark that we are concerned only with pure asthma, in the restricted sense of the word. All forms of paroxysms of dyspnœa, formerly often included under the name of asthma, will be excluded from the following discussion ; that is to say, those in which alterations in the bronchial mucous membrane, the parenchyma of the lungs, the heart, the large vessels, and the like, are amply sufficient to account for the trouble in breathing. These forms have often been designated by the term of symptomatic asthma.

Genuine bronchial asthma, the existence of which has become based upon facts since the discovery by Reisseissen of the presence of muscular fibres in the smallest bronchi, is characterized by attacks of sudden dyspnœa, coming on after longer or shorter intervals, increasing rapidly in severity,—the attacks being sometimes very severe,—and lasting either for a few hours only or even for several days.

It occurs both in the *idiopathic form*, in which no alteration can be discovered on the minutest examination of the organs during the intervals between the paroxysms, and in the *symptomatic form*, as, for example, in emphysema and chronic bronchial catarrh. In contradistinction to the forms of dyspnœa previously mentioned as erroneously attributed to asthma, and in which the dyspnœa is attributable to the alteration of the organs, this symptomatic form of asthma is characterized by the fact that here, also, the physical exploration of the respiratory, circulatory, and other organs, in no wise reveals sufficient alteration to account for the severe symptoms which appear so suddenly. We prefer this division into essential and symptomatic asthma to that which also includes under the name of symp-

tomatic asthma all those paroxysms of severe dyspnœa which can be sufficiently accounted for by anatomical changes.

Etiology and Pathogenesis.

Bronchial asthma, the cause of which has been located, since the investigations of Bergson (1850) and Salter (1859), in a spasm of the bronchial muscles, which spasm may be occasioned by a periodic excitement of their innervating fibres coming from the vagus nerve, may be produced *directly* by an irritation applied to the vagus at its origin or along its course, or may be excited in a *reflex manner* by irritation of various organs.

There is no case known in which it has been established with certainty that the bronchial spasm has been directly occasioned by influences proceeding from the nerve centre. Nevertheless, many facts favor the opinion that central irritation may be the occasion of many asthmatic paroxysms. The possibility of hereditary transmission is of much less weight in support of this view, than the alternation, occasionally observed, of asthma with other neuroses. Thus, Salter narrates a case in which asthmatic and epileptic paroxysms alternated with each other ; and Eulenburg[1] observed in several individuals alternations of asthmatic attacks with hemicrania and with angina pectoris.

Cases have also been repeatedly observed in which it was probable that the paroxysms of spasm were occasioned by swollen tracheo-bronchial glands, which irritated the branches of the vagus directly by occasional increased tumefaction (Biermer).[2]

Bronchial asthma arises much more frequently in an indirect, reflex manner, the origin of the attacks being not in the respiratory organs alone, but in the circulatory organs, in the abdominal organs, and the like. Thus the excitement of the bronchial branches of the vagus may sometimes originate in the sexual organs (uterine asthma), sometimes in the sensitive nerves of the intestinal tract, as in disorders of digestion, irritation from worms (dyspeptic asthma, verminous asthma), some-

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[1] Lehrbuch der functionellen Nervenkrankheiten. Berlin, 1871.

[2] Ueber Bronchial Asthma. Sammlung klinischer Vorträge, herausgegeben von R. Volkmann, 1870, No. 12, p. 55.

times from the sensitive nerves in the skin and mucous membrane, as in taking cold, and the like.

It has been recently remarked by Voltolini,[1] that nasal and naso-pharyngeal polyps not infrequently give rise to bronchial asthma ; and Haenisch [2] has very lately reported a confirmative observation. This case is of especial interest because the asthma not only disappeared with the removal of the polyp, but became re-established as the polyp grew again ; the same cycle of phenomena being repeated several times.

The frequent occurrence of asthmatic paroxysms in children has been repeatedly observed after measles and whooping-cough. Both Biermer and Williams believe that the etiological cause of the attacks is to be found in the enlargement of the bronchial glands, and the pressure made by them upon the vagus nerve.

Psychical and sensual impressions may occasion attacks in a reflex manner. The *nerves of smell* frequently take up this reflex action, and under the influence of certain irritations transfer the excitement to the pulmonary fibres of the vagus, the effect being manifested in a bronchial spasm. This form has been specially designated as "idiosyncratic asthma." Thus Itzigson [3] relates a case in which a merchant got the asthma every time fresh coffee was piled up. A dyer got the asthma whenever he used yellow-oak. In a florist it was always produced by lamp-black. The asthma occasioned by ipecacuanha has been repeatedly observed. Cullen narrated a case in which the wife of an apothecary got an attack of asthma whenever ipecacuanha was powdered in the shop. Similar cases have been reported by Trousseau, Lebert, and others. Trousseau relates of himself that he got the asthma whenever he remained in a room in which there was a bouquet of violets.

The so-called hay asthma, observed with especial frequency

[1] Die Anwendung der Galvanokaustik im Innern des Kehlkopfs und Schlundkopfs, etc., 2. Aufl., 1872.

[2] Zur Aetiologie und Therapie des Asthma bronchiale, Berlin. klin. Wochenschr., 1874, No. 40.

[3] Pr. Ver.-Ztg., 30, 1849.

in England, and which, as shown by the recent interesting investigations of Blackley,[1] is occasioned by the pollen of certain grasses, although it must be included among infective diseases in its restricted sense, must still, on the other hand, be placed in the same series with the forms of idiosyncratic asthma already mentioned.

As to the connection between these sources of injury and asthma, it may be attributed simply to a special irritability, so that the irritation is at once transmitted to the motor roots of the vagus; or else the fluxionary element may be regarded as the immediate cause. In those cases of catarrhal asthma which are occasioned by the odor of dried hay, fodder, rye pollen, and the like, Biermer sees a proof that fluxionary manifestations of the respiratory tract precede and accompany the asthmatic symptoms under certain circumstances. The odoriferous substances mentioned here excite a sympathetic disorder of the circulation, in the form of a fluxion, in addition to the perception of smell. Biermer is still more disposed to attribute a certain rôle to the fluxionary element in bronchial asthma, because other forms of asthma also frequently begin with bronchial catarrh. The nature of the connection between them, however, he leaves undetermined. This may be explained in three ways. Either the bronchial spasm and the catarrhal fluxion may be the common effect of a reflex excitement, or the catarrh may be the cause of the spasm, or the spasm may give rise to the fluxion secondarily. Clinical observation offers numerous proofs in support of the last view. There is not infrequent opportunity of observing cases of bronchial asthma in which all catarrhal irritation is wanting at the commencement, and in which it is first observed only at the end of the attack. In other cases, on the contrary, the train of symptoms is not to be explained by spasm of the bronchial muscles alone, especially in those cases in which moist râles, secretion of a more or less tenacious mucus, and its frequent expectoration are observed. In these cases an acute catarrh may give rise to the bronchial spasm secondarily.

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[1] Experimental Researches on the Causes and Nature of Catarrhus æstivus (Hayfever). London, 8., 202 pp.

We are therefore constrained to admit with Weber,[1] for many forms of asthma, the existence of an acute tumefaction of the bronchial mucous membrane in consequence of dilatation of its blood-vessels through vaso-motor nervous influence. Biermer justly remarks that as a congestion of the bronchial mucous membrane cannot be well recognized as long as the mucous membrane remains dry, it is possible that a fluxionary turgescence of the bronchial mucous membrane may have been the first to occur, even in cases in which the asthmatic attack apparently begins without catarrh.

As to the further etiological causes of asthma, *inheritance* plays a great and important rôle, according to many authors. Lebert is disposed to consider hereditary influence as very slight; and he states that, according to his own experience, inheritance has been the exception, and by no means the rule. According to other authors, asthma is often transmitted from the father to the son, or only to the grandchild, even when the father was no longer asthmatic at the period of his marriage or afterwards. Often asthma appears for the first time at the same period of life in which the father suffered most from it. In other cases only a certain disposition to neuroses in general is inherited.

Concerning the rôle played by the nervous element in the etiology of asthma, the fact may be of significance that men in general suffer with asthma much more frequently than women. Thus in a statement presented by Salter,[2] of 153 asthmatics 51 were females and 102 were males. The difference between the two classes at different ages is very remarkable. Thus, of twenty-three patients between 20 and 30 years of age, nine were males and fourteen were females; of nineteen patients between 50 and 60 years of age, sixteen were males and three were females. Thus during the period of life in which organic alterations of the lung are less frequent, and in which the nervous system is more sensitive, the females preponderate over the males as $3:2$; while at that period which presents organic diseases in increased propor-

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[1] Tageblatt der 45. Versammlung deutscher Naturforscher und Aerzte zu Leipzig, 1872, p. 159.

[2] An Analysis of a Hundred and Fifty unpublished Cases of Asthma, Lancet, II., 4, 1866.

tion, the males affected preponderate over the females as 5 : 1. The greater number of cases, according to Salter, commence in the first ten years of life, after this there is a gradual increase up to the fortieth year, and then there is a gradual decrease. Salter rejects the belief that asthma is a disease of age. In one-fourth of his cases the patients were under ten years of age, and the age was below forty years in four-fifths of the cases. According to the experience of others, asthma is infrequent in childhood, and by far the greatest number of cases are observed in middle life.

The connection of asthma with other diseases is to be mentioned among the other etiological conditions. Thus the attempt has been made by some observers to bring asthma into a closer relation with gout, and to distinguish a special form as *arthritic asthma*. They also perceive a relation with rheumatism, hæmorrhoids, and the like. A close association with chronic skin diseases has also been believed to have been repeatedly recognized. Thus Döllinger[1] believes that asthma, which is observed more frequently in warm climates than in cold ones, is often occasioned by the retrocession of eruptions, and is very frequently observed after the disappearance of herpetic affections. Waldenburg,[2] especially, has lately expressed himself in favor of the view of an antagonistic relation between asthma and affections of the skin. He proposes to designate this form as herpetic asthma.

It is furthermore worthy of remark that the congenital enlargement of the thyroid gland has been repeatedly blamed as the cause of asthmatic paroxysms. It is claimed that the obstacle to the respiration in these cases is in the entrance into the larynx, which is narrowed by the projection of the thyroid gland into the cavity of the mouth (Betz).

Although the above-mentioned enlargement of the thyroid gland may produce an impediment to breathing, and give rise to greater or less difficulty of respiration, such cases can by no means be included in the category of essential asthma as long as

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[1] Annal. de la soc. méd.-chir. de Liège, Juin, 1862.

[2] Die locale Behandlung der Krankheiten der Athmungsorgane, 2. Auflage. Berlin, 1872, p. 484.

the term asthma is not again, as formerly, more or less identified
with dyspnœa.   We have already referred, on a previous occa-
sion, to the distinctions between the differently localized impedi-
ments to respiration, and Biermer, especially, deserves the credit
of having brought out sharply the distinctions which exist
between the clinical pictures, and which are dependent upon
the different locations of the impediments to respiration.

We shall consider more closely the distinctions between these
individual varieties, in speaking of the differential diagnosis.
At present the remark suffices that the form mentioned above
does not belong to essential asthma.   Of many other varieties
described as asthma, it is also questionable whether they are to
be included under the head of essential asthma.

Attempts have also been made to establish a relation between
lead and asthma.   Lewy [1] has described a saturnine asthma as
an infrequent manifestation of lead poisoning, sometimes appear-
ing in the acute form, and sometimes in the chronic form.   It is
occasioned by the inhalation of the dust of white lead.   This
form is in general rarely observed, having occurred but twenty-
six times in 1186 cases of lead poisoning.

As to climatic influence, many are of the opinion that cli-
mates with brusque changes of temperature excite asthma.   A
fact remarked by Trousseau [2] deserves some attention, that is,
that a few individuals become attacked with asthma in certain
localities, and not in others.   Lebert, also, as stated in his
" Klinik der Brustkrankheiten," has had frequent opportunity
of witnessing the favorable influence of change of locality on
asthma.   According to Théry, [3] summer is less unfavorable than
winter to asthmatics, an assertion, however, with which Trous-
seau is not in accord.

Taking cold is not infrequently mentioned as the exciting
cause of asthma.   It is frequently observed that persons who
suffer with asthma get an asthmatic attack at once whenever
there is any sudden change of weather.   Winds which increase
the humidity of the atmosphere are supposed to cause the

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[1] Oesterr. Ztschr. f. prakt. Heilk. XVI., 6, 1870.

[2] Clinique médicale, T. II.   Paris, 1868.

[3] De l'Asthme.   Paris, 1859.

affection, but dry winds also are not infrequently prejudicial. Rosenstein [1] has said of Gröningen that the north-east wind especially is to blame in that locality, and that it is so apt to produce the affection that patients anticipate their complaint as soon as it begins to blow. Weber (l. c.), on the contrary, asserts that, according to his experience, light winds, on the whole, are not always unfavorable; on the contrary, many patients are better under their influence, even when they are specially exposed to the inclemency of the weather, for example, when they ride against the wind.

The night-time is to be mentioned as one of the best known disposing causes. Many patients are attacked by asthma only in the dark, and avoid the attack by burning a night-lamp. The understanding of the influence of light upon asthma is still rather difficult, despite Salter's attempts at explanation.

As regards the influence of different professions upon asthma, it is to be remarked that at all events it appears to occur with more frequency among certain of them, among preachers, lawyers, and teachers for example. No very great and constant preponderating frequency however is to be recognized in one station of life or another. Asthma occurs in general among the well-to-do classes more frequently than among the poorer ones, and especially in middle-aged males who lead a luxurious life. A plethoric constitution predisposes to asthma in a measure. Nevertheless, it is by no means infrequently observed among the poorer classes, especially among those who are advanced in years.

In similar manner the influence of damp, low dwellings, of residence in newly built and not yet thoroughly dried houses, has been cited as an exciting cause. Although these influences may be regarded as co-operative factors in the production of the complaint, they are not at all competent to excite asthma directly, as long as there is not a certain predisposition to it, a certain unknown something which enables such influences, not otherwise attended by like results, to call forth attacks of bronchial asthma. From all this, it appears that the ultimate cause for the production of the asthmatic paroxysm is unknown.

Turning, now, to the question of the manner in which asthma

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[1] Tagbl. d. 45 Versammlung Deutsch-Naturforscher u Aerzte. Leipzig, 1872.

occurs, in what its nature consists, we are again reluctantly com-
pelled to admit that with reference to this cardinal question, no
ultimate uniformity in the different opinions has yet been
arrived at.   Of course we must avoid the mistake, so frequently
made in practice, of confounding bronchial spasm with spasm
of the glottis, with paralysis of the dilators of the glottis, and
so on.   We will recur later to the differences in the clinical
pictures of these forms of disease, which are likewise associated
with dyspnœa, as compared with the characteristic paroxysms of
asthma.   Concerning the nature of essential bronchial asthma,
however, the opinions of different authors are still divided.
We refrain from a more detailed description of the older and
now abandoned theories concerning the nature of bronchial
asthma, and turn to the description of those which have more
or less value at the present day.

The view presented by Brée, for example, belongs in the first
class.   According to it, all the muscular exertion in asthmatic
attacks is but an effort to remove irritating material present
in the bronchi.   This irritating material is finally expelled as
mucus ; and then the paroxysm subsides.   Walshe believes that
the difficulty of respiration depends on a want of oxygen in the
blood,—the lungs being entirely sound,—which the patient must
compensate for by deep breathing, like the panting breathing
of healthy persons engaged in violent exercise, ascending moun-
tains, and the like.

Others, again, regard asthma only as a bronchitic dyspnœa,
which is sometimes occasioned by occlusion of the bronchi with
mucus, and sometimes by thickening of the bronchial mucous
membrane.   According to others, asthma is altogether depen-
dent upon paralysis of the bronchi.

Kidd considered a tonic spasm of the inspiratory muscles as
the cause of asthma.   Sanderson advanced the view that there is
a paralysis of the dilating muscles of the glottis and the contrac-
tile fibres of the lung tissue, with consecutive impediment to
expiration.

These and other theories, the enumeration of which is of no
interest, have long been abandoned ; and the dispute, at the
present day, is narrowed down to closer limits.

Even in the present narrow limits of dispute, there is as yet scarcely any prospect of agreement; and the different theories about to be mentioned are still maintained by their supporters with equal tenacity.

Of these theories the oldest, and at the same time the one which still counts the greatest number of adherents, is that which places the nature of asthma and its ultimate cause in a spasm of the bronchial muscles. This theory, which is of the most ancient origin, and which was defended by numerous authors, as Trousseau, Salter, Ramadge, Romberg, Lefèvre, Bergson, Théry, and others, has recently received important support in the experiments of Bert,[1] who has again substantiated the frequently contested results of Williams[2] and Longet, and likewise by the works of Biermer[4] and Leyden.[5]

Passing by the objections made by the older authors, almost entirely supported by theoretical discussions only, it was principally Wintrich[6] who, with weighty reasons, as it seemed, and supported by numerous personal experiments, denied the influence of bronchial spasm in the production of nervous asthma. The importance of the question before us justifies the presentation of a short account of the reasons urged by Wintrich against this theory.

Wintrich, both from the results of his experimental investigations, and especially from the physical signs during the asthmatic paroxysms, believed himself justified in the assertion that a nervous asthma, produced by spasmodic contraction of the smooth muscular fibres in the lung, is not possible, and that such a condition does not exist. While earlier experimenters, as Prochaska, Reisseissen, Haller, Williams, Longet, Volkmann, and others, were able to demonstrate, experimentally,

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[1] Leçons sur la physiologie comparée de la respiration. Paris, 1870.

[2] Report of the Tenth Meeting of the Association for the Advancement of Science, held at Glasgow, 1840. London, 1841; Gaz. méd. Paris, 1841, No. 38.

[3] Compt. rend. de l'Acad. des sciences, T. XV., 1842.

[4] Sammlung klinischer Vorträge, herausgegeben von R. Volkmann, No. 12, Ueber Bronchialasthma, 1870.

[5] Zur Kenntniss des Bronchialasthmas, Virchow's Archiv, Bd. 54.

[6] Virchow's Handbuch der speciellen Pathologie u. Therapie, V. Bd., 1. Abth. Erlangen, 1854.

the contractibility of the lungs through muscular force, Wintrich came to the conclusion, through his investigations, that the vital muscular forces of the lungs may indeed be active, but that they have a much smaller share in the contractile force of the respiratory organs, than the prolonged post-mortem elasticity of the elastic fibres and the like, which is entirely independent of nerve influence. It was, however, the physical signs found during the asthmatic paroxysm, rather than the results of his experimental inquiries, which led Wintrich to the opinion that a nervous asthma is utterly impossible as a result of spasmodic contraction of the smooth muscular fibres. Wintrich considers it impossible to explain the enlargement of the lungs with increased air-contents, observed by all authors during the attack, by a spasmodic contraction of the bronchial muscles. The limits of the lungs should be rather rendered smaller by the asserted muscular spasm, as it is not to be supposed that it would always obstruct the exit of the air during expiration, and, on the contrary, would admit it into the vesicles during inspiration. In the second place, according to Wintrich, if nervous asthma is actually able to produce, by means of the muscular spasm, that enormous hindrance to the respiratory function which is observed during the paroxysms, the muscular fibres must overpower both inspiratory and expiratory pressure in their action. The inspiratory air-pressure, however, is, in fact, not overpowered, for the lungs could not otherwise be made larger by increased quantity of air in the vesicles, and that the expiratory pressure can be overpowered by them, is held by Wintrich to be a physical impossibility. On the contrary, Wintrich believes that everything is easily understood in nervous asthma, if it is viewed as a momentary impediment to respiration, produced either by a tonic spasm of the diaphragm alone, or a similar spasm of the diaphragm and the respiratory muscles together; in connection with which, spasm of the glottis may or may not be associated.

This theory, first advanced by Wintrich, soon received a powerful support from Bamberger,[1] who, by means of a carefully observed case of asthma, furnished important contributions to the

[1] Würzburger med. Ztschr., Bd. VI., Hft. 1 u. 2.

pathology of the disease. The great retraction of the lower borders of the lungs in this case during the attack is especially to be mentioned, and likewise the fact that neither inspiration nor expiration exerted the slightest influence upon the limits of the lower borders of the lungs. During the deepest inspiration the upper limit of hepatic dulness did not vary the breadth of a line from its position during the deepest expiration. The same condition was found to exist with reference to the limits of cardiac dulness. The board-like hardness of the abdominal muscles collectively, mentioned in Bamberger's case, is of prominent interest.

As to the question of the mechanism of nervous asthma, Bamberger believes, as does also Wintrich, that with the depressed position of the diaphragm there can be no spasm of the bronchi, but, on the contrary, that all the manifestations are fully explained by tonic spasm of the diaphragm, and by the secondary antagonistic spasm of the muscles of expiration occasioned thereby. Bamberger considers it undoubted that there are asthmatic paroxysms, the cause of which lies in a tonic spasm of the diaphragm. He considers this the most frequent and most important cause of asthma, but not the only one, as he has observed very important differences in the constituent elements and in the entire form of the paroxysm in different patients. Sometimes the spasm was more inspiratory in character, and sometimes more expiratory. In the complicated nature of the respiratory acts Bamberger believes that different possibilities may be imagined. Thus in many cases the paroxysm may be produced by a more clonic spasm of most of the inspiratory muscles, as in hysteric asthma for example. A second possibility lies in paralytic conditions of the diaphragm; another possibility, not yet observed, exists in isolated spasm of the expiratory muscles, especially the abdominal muscles. Finally, there remains the spasm of the bronchial muscles, which is in the highest degree improbable, if not unimaginable; and here, according to Bamberger, inspiration and expiration, especially the former, must be laborious and prolonged. Biermer has recently expressed himself [1] strongly in opposition to these

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[1] Sammlung klinischer Vorträge, herausgegeben von R. Volkmann, No. 12.

views of Wintrich and Bamberger as to the nature of asthma, based as they are upon good grounds. He seeks again to vindicate for the bronchial muscles the rank accorded them by the older authors. On the other hand, he denies the tonic spasm of the diaphragm as a co-acting factor in the production of asthma. He justly asserts, in the first place, that the principle of asthma lies in *disorder of the expiration*, and that the remarkably prolonged and forced expiration, and the sibilant râles, indicate an obstruction in the medium-sized and minuter bronchi, which almost necessarily enforces the view of a spastic bronchial constriction. To the negative results obtained by Wintrich (l. c.) and Rügenberg,[1] on the influence of the vagus on the contraction of the bronchial muscles, he opposes the more recent positive investigations of Bert,[2] who succeeded, as Williams (l. c.) had done previously, in producing distinct contractions of the bronchi by galvanization of the lungs as well as of the vagus. It is therefore no longer doubtful that the bronchial muscles can be excited to tonic contraction under the domain of the vagus nerve.

Wintrich, however, has laid greater stress upon the physical signs than upon the negative results of irritation of the vagus, especially on the depressed position of the diaphragm, which he cannot associate with a spasmodic contraction of the bronchi; for which reason both he and Bamberger believe that a tonic spasm of the diaphragm must be regarded as the cause of the asthmatic symptoms. Biermer also recognizes this position of the diaphragm as a constant occurrence in bronchial asthma; but he does not regard it as the result of a tonic spasm of the diaphragm, but as due to an increased quantity of air contained in the lungs, a dilatation of the lungs, which is dependent upon spastic contraction of the bronchi. Apart from the improbability of a diaphragmatic tetanus continuing for hours, Biermer maintains that he has always been able to satisfy himself that the diaphragm contracts rhythmically during the asthmatic attack. The indistinctness of its movements is explained by the obstacle to its elevation during its relaxation furnished by the

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[1] Heidenhain's Studien des physiol. Instituts zu Breslau, 2. Heft. Leipzig, 1863.
[2] Leçons sur la physiologie comparée de la Respiration. Paris, 1870.

dilatation of the lungs. Even, also, where no movement of the diaphragm can be observed, it cannot be taken as an evidence of tonic diaphragmatic spasm, because the diaphragm may appear to be immovable from other causes.

Biermer asserts in particular that the bronchial muscles are the antagonists of the inspiratory muscles, and serve for expiratory purposes simultaneously with the elasticity of the lungs. Their functions have not yet been studied experimentally, and our knowledge of them rests more upon theoretic deductions than on positive foundations (Biermer).

According to Biermer's opinion, in which most authors coincide, tonic spasm of the medium-sized and minuter bronchial twigs must render inspiration and expiration more difficult; the disturbance of expiration, however, being more important than the disorder of inspiration.

Biermer thinks that the bronchial muscles in the spasmodic condition, may form a sphincter-like occlusion which is more readily overcome in inspiration than in expiration, and that the escape of the air from the alveoli is impeded. The exception taken by Wintrich, that the spasm of the bronchial muscles must be overcome by the greater antagonistic forces of expiration, such as elasticity of the lungs and thorax, the expiratory muscles and the like, is rejected by Biermer, who denies that the rôle of the expiratory forces is antagonistic to the bronchial muscles. The expiratory pressure, moreover, acts by no means only upon the contents of the alveoli—the bronchial spasm would be readily overcome thereby, as a matter of course—but acts upon the broncheoli also. The bronchi, during expiration, are subjected to the general expiratory pressure and to the pressure of the morbid contraction of the bronchial muscles; and it is thus understood how the compressibility of the bronchioli favors their further closure, under the influence of forced expiration rather than their further dilatation.

Another, and by far the most important objection urged by Wintrich, Bamberger, and Lehmann against the view of spasm of the bronchial muscles, is, as stated, the descent of the diaphragm. The low position of the diaphragm, according to these authors, is incompatible with spasm of the bronchi; while

all the symptoms may be explained with remarkable lucidity on the theory of a tonic spasm of the diaphragm and the consequent secondary antagonistic spasm of the muscles of respiration. Bronchial spasm, on the contrary, according to these authors, being in fact an obstacle to both acts of respiration, both inspiration and expiration must take place laboriously, slowly, and at great expenditure of muscular force, and this would be the case to a greater degree in inspiration, inasmuch as a somewhat greater amount of pressure is at disposal in the act of expiration. Furthermore, in spasm of the bronchi we should expect an elevated position of the diaphragm, diminution of the thorax on all sides, and probably also, greater retraction of the intercostal spaces (Bamberger).

The picture presented by these authors, as developed by bronchial asthma, is directly opposed to what is actually observed and designated by them as spasm of the diaphragm. Biermer justly asserts that the symptomatic picture referred to, which these authors attribute to bronchial asthma, might correspond rather to a pulmonary spasm, harmoniously involving the bronchi and the alveoli together, but not to a bronchial spasm. In real bronchial spasm, on the contrary, says Biermer, the inspiratory force becomes the antagonist of the bronchial muscles, and drives the air with force through the constricted bronchi into the alveoli. This air, however, escapes but slowly and incompletely, despite the assistance of all the expiratory forces in expiration. This insufficient ventilation and distention of the lung is followed, secondarily, by sensations of want of air and reflex straining of the respiratory forces.

Lebert, in his most recent article on bronchial asthma,[1] adopts a middle position between the theory which seeks the essence of asthma exclusively in a tonic spasm of the bronchial muscles, and that which believes it to exist chiefly in a tonic spasm of the diaphragm. Lebert is of the opinion that the tonic spasm of the diaphragm is not the first act in the asthmatic paroxysm, but that the tonic muscular spasm, on the contrary, is reflex, and begins in the bronchial muscles, in which it has its

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[1] Klinik der Brustkrankheiten, I. Bd., 2. Hälfte, 1873, p. 438.

main factor, and that thence the inspiratory muscles of the throat and chest are first excited to great forced activity, approaching clonic spasm, and the diaphragm to more tonic, though not continuous contraction; something similar being liable to take place in the abdominal muscles also. He considers a valvular sort of closure, such as Biermer supposes it, as hardly possible. Lebert sees a further objection to the sole action of bronchial spasm in asthma, in the rapid occurrence of enormous pulmonary dilatation. He believes that the dilatation would occur gradually, and not so rapidly, if spasm alone were its cause. Lebert believes that with the great inspiratory efforts which laboriously drive the air through abnormally contracted tubes, and by the greatly increased respiratory stimulation of the corresponding portion of the medulla oblongata and its respiratory centre, transferring a reflex spasm over the phrenic nerves, the diaphragm is excited to tonic contraction. The two taken together, the bronchial spasm as primitive, and the tonic diaphragmatic spasm as consecutive, perhaps associated with consecutive spasm of individual muscles of expiration, explain most completely the physical manifestations of the asthmatic paroxysm. With reference to the question of the possibility of such rapidly occurring extensive pulmonary dilatation from spasm of the bronchial muscles, Lebert calls attention to its absence in fibrinous acute bronchitis. "Here," says Lebert, "the obstruction is enormous; many bronchioles and alveoli are obstructed in greater part, the former less completely, because in them the fibrinous exudation is generally tubular. The dyspnœa usually reaches a very high grade rapidly ; yet we have but slight pulmonary dilatation, even at points bordering on the occluding masses or in their vicinity, no exaggerated resonance, no marked immobility of the lower portion of the lungs ; in short, this severe cylindrical constriction of many bronchioles does not lead to that pulmonary dilatation which is tolerably constant, very rapid, and very extensive in asthma.

It remains, finally, to briefly mention two more observations and theories of asthma, of very recent date.

Leyden,[1] in 1871, first drew attention to the coincidence of a

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[1] Virchow's Archiv, 54. Bd.

characteristic sputum in the lung affection, designated as bron-
chial asthma.

According to this observer, the expectoration is scanty during
the paroxysm, more copious after it; in general viscid, grayish-
white, very frothy, and containing in a transparent, almost vitre-
ous mass, a mixture of fine threads, flakes, and plugs, some of
which are distinguished by their dense dry consistence and
generally clear gray color.   These present, under the micro-
scope, a compactly matted bundle of brownish cells undergoing
granular degeneration, between which are more or less abundant
layers of crystals.   These crystals are colorless, have a dull lus-
tre, and always the form of very pointed octahedra.   They differ
greatly in size, some of them being so large that they attract
attention at once, while others are recognizable only by the aid
of strong immersion lenses.   According to the investigations of
Salkowski, they are readily soluble in water, especially in warm
water, and likewise in acids and alkalies; insoluble in ether;
and swell in glycerine until they become invisible.   The nature
of these crystals has not been determined with certainty; but
it is probable that they are composed of a crystallized substance
analogous to mucine.

As to the connection with the symptoms, Leyden advances
the probability that these fine-pointed crystals irritate the
peripheral terminations of the vagus nerve in the bronchial
mucous membrane, with reflex spasm of the musculature of the
smaller bronchi, and thus occasion all the symptoms of asthma.
Leyden's attempt to prove this connection experimentally has
not yet succeeded.   It is further worthy of mention, that similar
crystals had been previously observed by Friedreich, Förster,
and others, in dry catarrh and in croupous bronchitis.   These
are apparently identical with those found by E. Neumann in
the bone-marrow and blood of leukæmic patients.

The latest theory, and one well worthy of attention, is that
of Weber.[1]   Weber believes that in addition to spasm of the
bronchial muscles various other causes, such as acute catarrh,
diaphragmatic spasm and paralysis, insufficiency of the heart,

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Tageblatt der 45. Versammlung deutscher Naturforscher und Aerzte zu Leipzig,
1872, p. 159.

aneurism of the aorta, poisonings, etc., may occasion asthmatic manifestations, and that a difference in the symptoms may be observed according to the difference in the cause ; so that it is frequently possible to distinguish between the individual forms. The most usual train of symptoms, according to Weber, is as follows : dyspnœa caused by difficulty of inspiration and expiration, orthopnœa, whistling, sonorous and sibilant râles, cyanosis, sweating frequently, great anxiety and restlessness ; then moist râles, secretion of a more or less viscid mucus, frequent expectoration of this secretion, and with it abatement and disappearance of the dyspnœa. Such a paroxysm may continue half an hour, or it may last for days.

This group of symptoms, and especially the secretion of the mucous membrane, according to Weber, are not to be explained by diaphragmatic spasm or spasm of the bronchial muscles alone. Acute catarrh also is shown not to be the cause of the paroxysm in many cases, according to Weber. On the other hand, another hypothesis explains the collective manifestations the most naturally, namely, *the supposition of a tumefaction of the bronchial mucous membrane in consequence of dilatation of its blood-vessels through vaso-motor nervous influence.* Such vascular dilatation, with tumefaction of the mucous membrane producing a stenotic narrowing of the air-passages, frequently takes place in the nose ; and many people suffer very frequently from this often only momentary stopping of the nose, sometimes affecting only the one or the other nostril. By careful examination, the much congested and swollen mucous membrane can readily be recognized as the cause of the impeded passage of the air.

It might be conjectured, *à priori*, that, as the mucous membrane of the nose is anatomically very like the bronchial mucous membrane, and as the nose likewise belongs to the respiratory organs, processes may occur in the bronchi similar to those which take place in the nose. This opinion finds an important support in the fact that in many asthmatics the asthma is preceded by such stopping of the nose, which ushers in the paroxysm, or, as is less frequently the case, continues during the whole of it.

This theory, presented by Weber, finds a further important support in the fact that there are not only asthmatics in whom almost every acute bronchial catarrh, every "taking cold," at once occasions an attack of bronchial asthma, but it also happens that asthmatic attacks which apparently begin without the slightest catarrhal symptoms, nevertheless terminate with them. In these cases it appears as if the asthma occasioned a hyperæmia of the bronchial mucous membrane. As Biermer, however, justly advances, in these cases the possibility is by no means excluded that, even when the attack begins without catarrhal symptoms, a fluxionary hyperæmia of the bronchial mucous membrane may, nevertheless, be its primary manifestation.

The last-mentioned theory deserves our consideration the more that it is in full accordance with known physiological laws concerning vaso-motor nervous influence. I recall here only the well-known experiment of Lovén,[1] by which it was shown that, upon irritating sensitive nerves, a reflex vascular turgescence ensued in the domain of the irritated section. In an analogous manner we can suppose that whenever an irritation affects the bronchial or nasal mucous membrane, this irritation may excite a reflex vascular turgescence in this region.

Störck[2] has just entered the field as a decided defender of this theory of Weber, and, at the same time, an opponent of the theory of bronchial spasm. On the other hand, Störck admits that tonic spasm of the diaphragm plays a rôle in bronchial asthma, in addition to the acute tumefaction of the mucous membrane of the bronchioles.

Störck recognizes a special support for the supposition of an acute tumefaction of the bronchial mucous membrane in the fact discovered by him, that tracheoscopic inspection in asthmatic attacks showed great congestion both of the entire trachea as far up as the larynx, and partially, also, of the right bronchus.

Passing from the description of the most important theories

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[1] Ueber die Erweiterung von Arterien in Folge einer Nervenerregung. Arbeiten aus der physiol. Anstalt zu Leipsig, herausgegeben von Ludwig, 1867.

[2] Mittheilungen über Asthma bronchiale und die mechanische Lungenbehandlung. Nebst einem Anhang über den Hustenreiz. Stuttgart, 1875.

of asthma to the question, which of them corresponds best with the clinical symptoms, we must first remark that a complete uniform train of symptoms is by no means to be comprehended under the term "asthma." As long as a complete agreement as to the train of symptoms to be accredited to asthma has not yet been reached, a definite answer to the question, which of the current theories above mentioned is the only correct one, cannot be expected.

In this connection Biermer has rendered a real service; not only because he has so sharply delineated the clinical picture of essential bronchial asthma, but also because he has signalized with emphasis the preponderant expiratory dyspnœa of asthmatics, and has brought out sharply the differences between inspiratory dyspnœa and the predominant expiratory dyspnœa. This difference between inspiratory and expiratory dyspnœa is by no means sufficiently borne in mind; and consequently we still find the remark repeated in current writings on asthma, that a spasm of the glottis is often at the same time the occasion of the asthma. How essentially, however, the symptomatic pictures of asthma and spasm of the glottis differ, has been shown by Biermer in the clearest manner.

In referring to the chapter on symptomatology for the special train of symptoms occurring in bronchial asthma, I must mention, in reference to the different theories above presented, that the objections offered to the explanation of asthma as a spasm of the smaller bronchi, should be regarded as refuted by Biermer's recent detailed expositions, which we have reproduced above *in extenso*. That a depressed position of the diaphragm, and acute pulmonary dilatation are the necessary consequence of bronchial spasm, as of every sudden constriction of numerous bronchioles, has been proved by Biermer with such excellent reasons that any further discussion of the question may be abstained from in this place. Just as here an acute pulmonary dilatation ensues, under the influence of sudden, though not absolute obstruction, so we see, in an analogous manner, chronic pulmonary dilatation, actual emphysema, become developed in chronic catarrhs in consequence of the slowly developed but continuous obstruction. While, therefore, on the one hand, there can be no doubt

that the symptomatic picture of asthma may be produced under the influence of intense obstruction in numerous small and minute bronchi, as occurs in bronchial spasm, yet the question is by no means decided, on the other hand, whether the bronchial spasm is always primary, or whether it is not rather a secondary manifestation.

That the fluxionary element also plays a rôle in bronchial asthma is beyond a doubt. This is proven by the catarrhal symptoms attending every attack, and sometimes appearing with special intensity at the close. Towards the close of the attack, there is more or less discharge of bronchial secretion, corresponding, as a rule, with the appearance of numerous moist râles. On the other hand, the question is less easily answered, in what connection the congestion of the bronchial mucous membrane stands to bronchial spasm. Biermer has already considered this question, and has suggested, among other possibilities, that as a congestion of the bronchial mucous membrane, so long as it remains dry, cannot be well recognized, and at least cannot be distinguished by physical signs from an asthma commencing simultaneously, so also in these cases in which the asthmatic attack apparently commences without catarrh, a fluxionary turgescence of the mucous membrane of the bronchi may have preceded, and increased secretion during the height of the attack may or may not follow.

A further possibility, suggested by Biermer, is that the bronchial hyperæmia is a consequence of the asthma ; a relation that has been especially maintained by Trousseau. Finally, both the hyperæmia and the spasm of the bronchi may be regarded as co-effects of an irritation of the nerves of sensation.

Weber and Störck treat the subject in another manner, inasmuch as they also attribute an important rôle to the fluxionary element, but, in contrast to Biermer, endeavor to explain the entire train of symptoms by this alone. Störck, in particular, sees an important support to this theory in the fact that he has repeatedly observed great congestion of the trachea and a portion of the bronchi, on tracheoscopic examination during the attack. At the same time he is compelled, at least in certain cases, to adopt the theory of a tonic spasm of the diaphragm.

The view that there is sudden tumefaction of the mucous membrane of the bronchioles, in bronchial asthmatic attacks, has much probability in its favor ; and the view that this tumefaction is the primary movement of the entire attack, is rendered the more probable, when we consider that, as a rule, there is a sero-mucous bronchial secretion after a short duration of the paroxysm, and, furthermore, that this increased secretion must always be preceded by a hyperæmia, which has been proven to be actually present by Störck's investigations ; and finally, that analogous sudden tumefactions at other portions of the respiratory apparatus, the nasal mucous membrane for instance, are likewise observed by no means infrequently.

Although, therefore, the opinion that bronchial asthma is always ushered in by an intense hyperæmia, is becoming more and more plausible, the question still remains for discussion, whether the entire symptomatic manifestations of the asthmatic attack can be explained by this hyperæmia alone, or whether we must accept an accessory spastic element.

It is in this last point that the difference culminates between the views of Weber and Störck on the one hand, and those of Biermer on the other. Biermer himself first suggested the possibility that fluxionary turgescence of the mucous membrane of the minuter bronchi might be the first phenomenon of asthma. Even Störck,[1] in combating the theory of bronchial spasm on the one hand, finds himself inclined to the opinion, on the other, that the diaphragm may be excited to tonic spasm.

While I am willing, upon the grounds above mentioned, to concede a more important rôle, than has been hitherto assigned to it by most observers, to the fluxionary element in the production of bronchial asthma, and to admit that the acute tumefaction of the mucous membrane of the bronchioles is the primary element of asthma, I consider it going too far to endeavor to explain the entire symptomatic picture by these conditions alone. This explanation may suffice, perhaps, for very mild grades of the affection. But that the severer grades, in which the patient forcibly struggles for air, in which, despite the assist-

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[1] L. c., p. 15.

ance of all the auxiliary muscles of respiration, he is still tortured with the most painful hunger for air, so that the dread of death evinces itself; in which phenomena of the intensest pulmonary dilatation become developed within a short period, can be explained by the mere tumefaction of the mucous membrane, appears to me improbable. Here a second factor must be associated, and that this can be only the spastic element is evident. How otherwise shall we explain the frequently observed rapid amelioration after the administration of chloral hydrate, and similar remedies? In this sudden disappearance of the alarming asthmatic manifestations, after the employment of chloral hydrate, Biermer justly recognizes an evidence that spastic processes play a rôle in the manifestations. To explain, with Störck, the restoration of free respiration after the employment of chloral hydrate, or morphia, by a sudden subsidence of the tumefaction of the mucous membrane, resulting from the use of these remedies, may, at any rate, be somewhat disputed; and cannot be supported by any other analogous manifestation. According to the view given above, in which we have attributed a prominent rôle to acute tumefaction of the mucous membrane, it is also comprehensible how chloral hydrate fails in its effects in many cases; how the use of this or similar remedies is not infrequently followed only by moderate amelioration, and by no means by a complete cessation of the asthmatic symptoms. It is easy to understand, however, that the pulmonary dilatation and the deep descent of the diaphragm will be more marked when a spasm of the bronchial muscles is superadded to the constriction of the minuter bronchi occasioned by swelling of the mucous membrane. The simple swelling of the mucous membrane can hardly suffice to occasion such intense pulmonary distention as is constantly observed in the severer grades of asthma. Both together, however, if the inspiratory force is not too much enfeebled, must lead to acute pulmonary distention as a necessary consequence.

At the same time, it can by no means be denied that cases occur in which a spasm of the diaphragm may be superadded secondarily. That here, however, the symptoms must vary in many points from those which occur in pure bronchial asthma,

hardly needs any special affirmation. But in no instance can the nature of asthma be found in a diaphragmatic spasm alone, and this be considered as the primary phenomenon.

An entirely different picture must be presented if there is spasm of the glottis, whether it be primary or secondary. In our description of the symptoms, and of the differential diagnosis, we will have occasion to speak more in detail of the differences between these individual forms of dyspnœa. It appears, therefore, of essential importance to separate sharply the symptomatic pictures of the individual forms of dyspnœa, according to the different locations from which they originate. Here, however, we are especially concerned with that form only which has been designated as bronchial asthma in the restricted sense of the word. In the following pages, therefore, only that form will come under description which is distinguishable as pure bronchial asthma.

With reference to the theory presented by Leyden, which plausibly attributes the occurrence of bronchial asthma to the presence of the crystals previously mentioned, a greater number of observations must first be made before we can arrive at a definite conclusion. At any rate, this theory gains in probability if we accept hyperæmia as the principal factor in the affection. The fact that the same crystals have been found in other cases than those of asthma, by no means militates against regarding them, in individual cases, as the exciting cause of the hyperæmia and the bronchial spasm.

Anatomical Alterations.

In bronchial asthma there can be no essential anatomical alterations. It belongs to the functional neuroses, and is characterized, at least in accordance with the general opinion, by the very absence of anatomical alterations.

In so far as a series of diseases of the respiratory and circulatory organs dispose to asthmatic attacks, a series of anatomical changes will not infrequently be found in the dead body. These, however, cannot be brought into direct relation to asthma, but only into remote relationship, as is also evident

from the fact that these diseases are at least just as frequently observed without being followed by asthma. In so far as long-continued and oft-returning asthmatic attacks frequently occasion a series of alterations in the respiratory and circulatory organs secondarily, and inasmuch as the asthmatic attack, as such, is not fatal, but may become so eventually by reason of consecutive manifestations and complications, it is comprehensible how the existence of an idiopathic asthma was so long doubted, and how asthma was brought into direct relation with a series of anatomical alterations.

Catarrh and *emphysema* occupy the most important rôle among the sequelæ of asthma; and, on the other hand, it has long been established that chronic bronchial catarrh and emphysema belong to the most frequent, though at the same time remote, occasioning causes of asthma.

Inasmuch as all observers, as already stated, agree in the experience that the asthmatic paroxysm hardly ever brings life into direct jeopardy, no matter with what severity its manifestations may be ushered in, there is no opportunity to make any direct examinations in this direction. The fact that, in pure bronchial asthma, every subjective disorder, every objective alteration, is wanting outside of the period of the attack, speaks against the existence of any special anatomical lesion as the substratum of the affection.

If we have thus far spoken only of negative anatomical results, this applies only to the actual examination of the dead body. As we have already mentioned, in speaking of the mode of origin of the disease, not only do the clinical facts lead to the assumption that a severe congestion of the bronchial mucous membrane takes place during the attack, but Störck[1] has even adduced direct evidence of the correctness of this view, he himself having demonstrated by tracheoscopic examination that the mucous membrane of the trachea and main bronchi is intensely reddened during the attack. But if this is true of the larger bronchi, we are certainly justified in accepting the same view with regard to the mucous membrane of the smaller ones;

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[1] Mittheilungen über Asthma bronchiale. Stuttgart, 1875.

and even to a greater degree. It is self-evident, however, that this hyperæmia can hardly be subjected to anatomical demonstration.

On the other hand, it cannot be wondered at that long continued and frequently recurring attacks may lead, in the course of time, to permanent anatomical alterations. In this category belongs chronic catarrh, which, on the one hand not infrequently attends the asthma, and on the other is one of its not infrequent consecutive manifestations. This is the more readily understood if we incline to the view just mentioned, namely, that congestion is the introductory element of the attack of bronchial asthma.

It is still easier to understand how, after the frequent recurrence of such asthmatic attacks, which are always attended with excessive pulmonary distention, a permanent loss of elasticity of the pulmonary alveoli, and even an actual emphysema, may result.

Symptomatology and Course.

Like many other neuroses bronchial asthma has a more or less typical course. It consists of attacks of dyspnœa and oppression, which come on usually at irregular intervals, sometimes occurring more frequently and sometimes less frequently, and interrupted by shorter or longer periods of complete comfort. In the intervals between the attacks, the functions of the respiratory organs appear altogether undisturbed, at least in the idiopathic forms of the affection.

In the majority of cases the attack begins unexpectedly, and usually during the earlier hours of the night. The patient, having gone to bed perfectly well, is suddenly awakened in the night, while sleeping quietly, by an intense sense of oppression and anxiety. Breathing is very laborious, and the respiration is attended with audible whistling and rattling ; and the dyspnœa rapidly increases to an excessive degree. The cyanosis increases from minute to minute, the face becomes bluish red and turgid, the eyeballs protrude, the patient supports himself on both arms to struggle powerfully for air, and the face becomes bathed in perspiration. The patient can no longer get his breath in the recumbent position, and often assumes the most varied

attitudes in order to appease in a measure his craving for air. Sometimes he sits up in bed and supports his shoulders with both arms, in order to diminish the size of the thorax by the assistance of the firmly contracted abdominal muscles. The expiration is thus rendered especially loud, groaning, whistling, and audible at a distance ; and it is proportionately longer than the inspiration. Soon the patient hurries to the window to struggle for a mouthful of fresh air. In spite of all this he does not succeed in appeasing his craving for air, even by the forcible action of all his auxiliary muscles. The paroxysm continues at this height for a long time,—one, two, or more hours,—and then it gradually subsides. The respiration becomes easier again, the cyanosis disappears, the patient feels gradually freer and freer, and then drops off into a quiet, deep, uninterrupted sleep. In many cases the patient feels completely well, until a fresh paroxysm, frequently coming on at the same hour, reproduces the same severe train of symptoms, upon the subsidence of which, the patient again feels completely well, until overtaken by another paroxysm. In this manner the paroxysms recur again and again, for weeks or months, in a more or less irregular manner, to disappear altogether eventually, or for a long period.

There are many deviations, however, from this course, which we have just described, and which characterizes true asthma. Thus it happens, by no means infrequently, that the attack is preceded for a shorter or longer time by prodromal manifestations, a sort of aura in fact, which announces to the patient the approach of a paroxysm. Sometimes there is a sensation of constriction in the throat, sometimes abnormal sensations at the epigastrium ; sometimes the attack is preceded by gaping, or severe sneezing, and the like. In many cases the asthmatic paroxysm is ushered in by severe acute coryza. The patient, who has hitherto felt perfectly well, is suddenly attacked by an exceedingly severe, obstinate fit of sneezing, which leads at once to greatly increased secretion from the nasal mucous membrane ; the eyes become injected and the secretion of tears augmented. These symptoms then give place, with or without a pause, to the essential asthmatic paroxysm.

In other cases, again, the asthmatic attacks continue for days

or even weeks, with but slight remissions, so that the patient is no longer able to attend to his employments during the time. The slightest exertion, or any emotional irritation, at once increases the dyspnœa, and the paroxysms increase during the night to an almost unbearable degree, so that the patient is hardly able to secure a position in which he can be more comfortable. Sometimes the patient is no longer able to remain in bed ; soon, again, he must have his bed so arranged that he sits in it rather than lies upon it ; soon, again, he finds that he has no rest in any position, so that he is constantly changing it.

There are not infrequent exceptions to the rule that the asthmatic paroxysm usually begins before midnight. Trousseau, who suffered from asthma himself, relates that he formerly had his paroxysm always at about three o'clock in the morning, and that he was regularly awakened from sleep at this hour by a sense of oppression. His mother, on the contrary, from whom he had without doubt inherited his asthma, had her attacks between eight and nine o'clock in the forenoon. Trousseau further relates the case of a tailor, who was so regularly attacked with asthma at three o'clock in the afternoon, that Trousseau suspected malarial disease, a sort of masked intermittent, on account of this very regularity. As a matter of course, quinine was without any influence on the paroxysms.

Cases of diurnal asthma, however, are exceptional, and the rule must be accepted that the attacks occur chiefly at night.

In other cases, again, as remarked by Trousseau, the asthma takes on the catarrhal form,[1] in which the bronchitis, which so often, and in fact ordinarily, terminates the paroxysm, appears to represent the only expression of the attack. This form of asthma is observed with especial frequency in children, though it is not altogether infrequently observed in adults also. It is of significance, however, in these cases, that the intensity of the dyspnœa stands in no relation to the auscultatory manifestations. Trousseau not only deserves the credit of pointing out the

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[1] *Trousseau*, like *Biermer*, accepts two forms of asthma, idiopathic and catarrhal. According to the opinion advanced by ourselves, that every asthma is associated with congestion of the mucous membrane, in addition to the spasm of the bronchioles, this subdivision is superfluous.

frequency of asthma in children in general, but he was also the first to pay attention to the characteristic forms under which it occurs in children. As Trousseau remarks, it must be considered exceptional when asthma occurs in children in the same form as in adults, and he states that for his own part he has seen but a single such case. According to Trousseau, asthma occurs in children much more frequently in the catarrhal form, so that it may readily be confounded with genuine catarrh. Although the catarrh is marked in these cases by more severe manifestations than in cases of simple genuine bronchial catarrh, it is much more easy to subdue the disease at once than genuine bronchial catarrh, as soon as the spastic element is directly attacked. This form offers some difficulties for the diagnosis; still, it can always be recognized on careful consideration. Sensations of great oppression, feelings of anxiety and the like occur from time to time, especially at night, and continue even when the catarrh is already on the decline, or is in course of extinction. An important characteristic element of this form of asthma lies in the lack of harmony between the catarrhal and the nervous symptoms. The general disturbances are also absent in these cases, fever especially, almost completely, while the manifestations on the part of the respiratory organs come on with excessive turbulence. Finally, a very characteristic feature of this form of asthma lies in the sudden, almost causeless subsidence of the paroxysm, as well as in its rapidly recurring and equally causeless return. The catarrhal element, therefore, plays only the rôle of an immediate cause. It coincides in a certain measure with the spasmodic paroxysm, but not in such a way that it can ever be considered as a rule that the severity of the catarrhal symptoms is proportional to the degree of nervous disorder. On the contrary, it appears that the same individual who to-day, with a slight bronchitis, is attacked by a very severe asthmatic paroxysm altogether out of proportion to the slight degree of change in the bronchial mucous membrane, on another will not suffer the slightest nervous or spastic attack with a much severer bronchitis (Trousseau).

Let us now turn from this short general delineation of the

most important forms under which asthma appears to an analysis of the individual symptoms.

As already mentioned, the paroxysm begins before midnight as a rule; less frequently after midnight. If no prodromes have preceded, the patient is awakened suddenly out of sleep by a sensation of severe oppression and dyspnœa. This dyspnœa rapidly increases to a very intense degree, to complete orthopnœa. The patient now seeks in every manner to satisfy his need of fresh air; sometimes he runs to the window and opens it, hoping thus to secure some amelioration; sometimes, as he is no longer able to lie in bed, he leans hard upon his arms so as to facilitate breathing. Respiration goes on laboriously, noisily, with many râles; a loud whistling sound is heard on inspiration, often audible at a distance; the same is heard, but with greater intensity, in expiration, which is considerably prolonged, and is performed with the assistance of all the expiratory forces. The intense anxiety and desire for breath is most distinctly imprinted on the countenance. More or less intense cyanosis of the face is often rapidly developed; the alæ of the nose are powerfully agitated; and even a short time after the commencement of the attack the entire terrifying train of symptoms is completely developed, and continues for a long time; hours usually, but even days sometimes, with slight remissions. Often a profuse cold sweat covers the entire body. The peripheric portions of the body, the face and extremities particularly, usually feel cold.

With regard to the position of the body during the paroxysm, the patient, as already mentioned, is almost without exception unable to retain the horizontal position. Sometimes he sits upright in bed, leaning firmly on his arms; sometimes he is no longer able to remain in bed even in this position, and he rushes to an arm-chair or to the open window. It must be regarded as an exception that in the case so clearly and distinctly described by Bamberger,[1] the patient constantly retained the horizontal position on his back during the paroxysm, that he did not make the attempt to sit up, to support himself on his

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[1] Würzburger med. Zeitscher, VI., Heft 1 u. 2.

arms, or even to raise his head higher, and that no movement took place except a restless tossing to and fro of the trunk from side to side when the spasm reached a great degree of severity. The latter point—the avoidance of forcible movements—applies certainly to the majority of asthmatic attacks up to a certain degree of severity. The patient anxiously avoids every movement in order not to increase the already excessive dyspnœa by the muscular effort.

The number of respirations is usually diminished during the asthmatic paroxysm, as mentioned by Bamberger, on account of the considerable prolongation of the expiration. The inspiration is proportionately short, but deep and powerful ; the upper portion of the thorax is strongly raised, often much more than in the normal condition, as I have demonstrated by comparative graphic measurements during the paroxysm and at other times. The lower portion of the thorax not only often bulges but very little forwards, but sometimes even sinks a little backwards, in the severest cases, towards the vertebræ. This disproportion is especially pronounced in male patients, in whom, as is well known, during normal respiration, the extent of movement increases, as a rule, the lower the portion of the thorax. The upward movement of the thorax is considerably increased thereby. At the same time the sterno-cleido-mastoid, the scaleni, and other muscles contract powerfully, and the shoulders are strongly raised.

Expiration, however, exhibits more important deviations from the normal act than does inspiration. While inspiration, as Bamberger pertinently remarks, shows nothing that varies from an ordinary powerful and somewhat forced effort, expiration presents the picture of a most laborious and tormenting, and at the same time fruitless struggle. It lasts from two to three times as long as inspiration, and in very severe cases even longer. All the expiratory auxiliary muscles are spasmodically tense, and the abdominal muscles collectively are contracted so that in severe cases the slightest impression cannot be made upon them with all the force that can be exerted. In individual cases, as for example in the one reported by Bamberger, this tension of the abdominal muscles was so great that the urine

always escaped involuntarily during the attack ; and sometimes the fæces also. Despite all this severe, powerful, muscular effort, a sufficient contraction of the thorax cannot be effected.

While, as above stated, the number of respirations is not increased during the paroxysm, despite the severity of the dyspnœa, but, on the contrary, is usually diminished, a temporary acceleration is sometimes observed if the patient endeavors to change his position, or any other special factor acts momentarily. Otherwise a diminution, or at least a want of acceleration of the number of respirations is observed as a nearly constant symptom.

In seeking an explanation of this diminution in the number of respirations, despite severe dyspnœa, I must recall the analogous and long known reduction of the number of respirations in croup, laryngeal stenosis, and the like ; only that instead of expiration as here, it is inspiration which appears greatly prolonged and laborious. This manifestation may be explained in a manner analogous to that by which I have previously explained this reduction when accompanying constriction of the larger air-passages.[1] It is just in this prolongation of the breathing, as I have there shown, that an important means of compensation is given to the severe dyspnœa in the lengthening of one phase of respiration, while, conversely, accelerated respiration would only increase the dyspnœa under these circumstances.

The result of *tracheoscopic examination*, exhibiting considerable congestion of the mucous membrane of the trachea, and partially of the bronchi (Störck), has already received mention on a previous page.

The results furnished by *percussion* are of especial interest. While at all other times the lungs remain within normal limits in pure uncomplicated cases,—the limit of clear pulmonary resonance, for example, corresponding, on the right side and in front, to a point somewhere about the lower edge of the sixth rib anteriorly in the mammary line,—during the paroxysm they extend considerably lower, say two inches and even further downwards, to the depth which is observed in cases of the utmost emphysematous distention of the lungs. In an analo-

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[1] *Riegel*, Die Athembewegungen, Würzburg, 1872, with 12 tables ; A. Struber.

gous manner, as a matter of course, the lower border of the liver is lower, and extends more or less beyond the ribs. The extent of cardiac dulness is sometimes diminished, in consequence of the distention of the edges of the lungs. The pulse is often remarkably small, and sometimes even very weak.

A further very significant result of percussion *is the slight change of the limits of the lower edges of the lung during inspiration and expiration.* In individual cases, as for example, in that reported by Bamberger, which deviates in many conditions from the ordinary symptomatic picture of bronchial asthma, inspiration and expiration have not the slightest influence upon the limits of the lower border of the lungs. Even with the deepest inspiration the upper limit of hepatic dulness did not deviate the breadth of a line from its position during the deepest expiration. In the majority of cases there is a movement of the border of the lungs, though slighter than in the normal condition.

A third deviation revealed on percussion of the lungs is an alteration in the volume of the percussion resonance. During the asthmatic paroxysm, the percussion resonance shows a remarkable increase of volume, and with it a distinct tympanitic quality, usually in the lower portions of the thorax, especially behind and on the sides. Biermer terms this resonance "band-box tone," on account of its resemblance to the percussion sound of a pasteboard bandbox. The physical cause of this modification of resonance is due, as is easily understood, to the greater distention of the alveolar tissue.

The same sound will be observed wherever dilated and more distended portions of the lungs of some size are found lying against the thoracic walls. Concerning the retrocession of these changes (as ascertained by percussion) to the normal standard, after the termination of the paroxysm, it may be remarked, that it does not usually take place immediately after the termination of the paroxysm, but only gradually. As a rule, however, the organs mentioned have again resumed their normal limits within a few hours.

On *auscultation* the first thing remarked is the absence, masking, or enfeeblement of the vesicular respiratory murmur.

Usually no vesicular respiration at all is audible at the lower
portions of the thorax; and in the upper portions it is some-
times also almost entirely absent, or is very much enfeebled.
Nevertheless the breathing during the paroxysm is so loud and
rattling, especially the expiration, that it can be distinguished
at a considerable distance. The respiration has withal a pecu-
liar whistling, sibilant tone, audible both in inspiration and in
expiration, but unusually intense in the markedly prolonged
expiration. The dry, sonorous rhonchi, audible especially dur-
ing expiration, and which not infrequently merge into moist
râles towards the end of the attack, are peculiarly characteristic.
These rhonchi are usually considerably shorter and weaker dur-
ing inspiration than in expiration, and so loud, as a rule, as to
completely mask the remaining respiratory sounds.

Concerning the assistance of other accessory forces, it has
already been mentioned that a great number of auxiliary
muscles are brought into action according to the degree of the
respiratory obstruction. Corresponding to the nature of the
obstructions, which concern expiration mainly, it is especially
the expiratory auxiliary muscles which are called into action.
As pertinently remarked by Bamberger, the expiration is at-
tended with a true tetanus of the expiratory muscles; and the
tightly stretched recti often project as board-like ridges.

That speech and cough should be considerably impeded under
such circumstances, hardly needs special mention.

The *sputum* is usually scanty, and is almost always com-
pletely absent in the beginning. As a rule, it is first discharged
towards the end of the attack. It is frequently very frothy,
grayish-white, and sometimes colored reddish-gray from bloody
admixture. On close examination with a lens, small yellowish-
green clumps are often found in it, which are dense and elastic,
and which with some difficulty can be crushed under the cover-
ing glass to a dull, glistening, crumbly, dry mass. In these
clots the crystals already described (Leyden) are often found
imbedded in great quantity. Furthermore, granular mucus cells
are found, in which, often, these crystals are imbedded; and
pus cells also, and ordinary mucus cells, and cylindrical and
ciliary epithelium. Many cells show, sometimes, the so-called

myeline metamorphosis, an alteration into pale, roundish masses, similar in appearance to myeline (Leyden).

In rare exceptional cases the train of symptoms characterizing bronchial asthma extends chiefly over only one-half of the thorax; and it is evident that the physical signs mentioned must be developed chiefly on this side also.

The temperature of the body shows no important deviation from the normal standard. I have repeatedly observed a remarkably low temperature during the paroxysm, lower than that found between the paroxysms. The peripheric portions of the body—the face especially—are usually cool, and more or less cyanotic.

As to *the subjective symptoms, and the disorders on the part of the nervous system,* the patient complains, during the attack, of the greatest oppression and dyspnœa. Consciousness is always maintained in the pure uncomplicated forms of asthma. In severe cases the patient sometimes appears as if stupefied. Cases are only very rarely observed in which consciousness is lost during the paroxysm. Thus in the case reported by Bamberger, the consciousness, retained during moderate attacks, regularly disappeared in severe attacks, after the spasm had lasted some time. In such cases, associated with disorder of consciousness, sometimes opisthotonous and tetanic spasms of the trunk and the extremities are observed, and even twitchings of the muscles of the face.

The further course of this affection is subject to extremely numerous variations. Sometimes only a few paroxysms occur, sometimes very many. Sometimes the paroxysms are relatively mild at the commencement of the disease, and recur only at great intervals, to increase, later, in number, and also in intensity. Sometimes, again, the paroxysms occur with extreme severity from the very beginning. The disease sometimes suddenly ceases spontaneously, after having resisted all remedies for months, and even years, and never returns.

The asthma of children is relatively favorable in this respect, inasmuch as it often ceases spontaneously after a short time, or else at the period of puberty. On the other hand, when commencing in middle life, asthma continues not infrequently for

the entire remainder of the patient's existence, although with manifold fluctuations and interruptions.

It has already been mentioned on a previous page that two chief forms of asthma have been distinguished : a so-called essential or idiopathic asthma, and a symptomatic asthma. The former form is distinguished by the circumstance that the patient is entirely well between the intervals of the attacks, and that the most accurate examination reveals no alteration of the organs. In the second form, on the contrary, there are different affections, especially of the lungs, the large vessels, and the heart, which must be brought into close or remote causal connection with the asthma. Chronic bronchitis and emphysema especially belong to this category. In those cases in which the catarrhal element prevails, we may, perhaps, be disposed to attribute the dyspnœa directly to a sudden increase in the bronchitis. Such a conception, as has repeatedly been advanced, must evidently be regarded as erroneous. The nature of asthma must be regarded as a pure neurosis, because even in those cases which are simultaneously coincident with catarrhal or other symptoms, the severe dyspnœa occurring periodically can never be explained by the catarrhal or other disorder without the assistance of other special factors. On the other hand, both catarrhal inflammatory processes of the bronchial mucous membrane and emphysema represent not infrequent sequelæ of frequently recurring and long-continuing severe asthmatic paroxysms. If, as we have already explained, an acute pulmonary distention always exists in the asthmatic attack, if the limits of the lungs reach further down, and the expiration always appears impeded to a great degree, so that, despite the assistance of all the expiratory forces, the thorax cannot be diminished, or the lungs reduced to their normal volume, then it is easy to comprehend how, in the frequent recurrence of such attacks, the lungs eventually remain distended beyond their normal dimensions, and how actual emphysema or chronic dilatation may result from the acute pulmonary distention. Something analogous applies to catarrh. We have already mentioned that even in those cases in which the asthmatic seizure is not ushered in by any apparent manifestations of congestion, such conditions are very prob-

ably always present in the beginning. It is then very easily
comprehensible how, from the frequent recurrence of such asth-
matic attacks, permanent disorders of the circulation and nutri-
tion of the bronchial mucous membrane may result from this
temporary congestion.

Diagnosis.

It might be supposed that the separation of bronchial asthma
from other forms of dyspnœa presented no difficulty at all. This
is not the case in fact. Bronchial asthma has, as a matter of
course, its own peculiar type, so that on careful consideration
of all the points no difficulty will be experienced, usually, in
distinguishing it from all related forms of dyspnœa. The com-
plete integrity of the circulatory and respiratory organs, and
the perfect good health between the seizures are of special im-
portance ; but this applies only to the true uncomplicated form
of pure nervous bronchial asthma. As already mentioned,
attacks of asthma are not infrequently superadded to various
other affections, especially those of the heart and the lungs;
and in these cases, as a matter of course, the point mentioned
loses its differential diagnostic significance. In such cases it may
readily be confounded with the symptomatic difficulties of res-
piration, which are occasioned by the fundamental disease,
especially by catarrh and accumulations of mucus. Neverthe-
less it is easy even here to distinguish this form [of dyspnœa
from that occasioned by spasm of the bronchi. The latter never
keeps step with the physical changes, and is especially occa-
sioned by a series of mere accidental causes. Hence an impor-
tant differential indication is afforded in *the sudden and appa-*
rently causeless onset of the paroxysm of dyspnœa, and in the
disproportion between the physical changes and the severity of
the dyspnœa. Notwithstanding, then, the fact that the asthma
is attended by evidences of hyperæmia and swelling of the
bronchial mucous membrane, so that one feels repeatedly dis-
posed to attribute to this local disorder alone the dyspnœa as it
occurs in the paroxysms, we must not forget, on the other hand,
that an important differential indication lies in the fact that this
sudden seizure of severe dyspnœa, as it occurs in genuine

asthma, can in no wise be sufficiently explained by a simple hyperæmia and swelling of the mucous membrane. Even intense acute catarrh hardly ever leads to such severe dyspnœa and such intense pulmonary distention as are constantly observed in attacks of asthma.

The forms mentioned, however, are not so likely to be mistaken for genuine bronchial asthma as certain other forms of dyspnœa, which also occur more or less suddenly. To this category belongs especially the dyspnœa, often extremely severe, occasioned by *spasm of the glottis*. Such confusion still occurs daily in practice ; but it can hardly continue if we distinguish more closely than has been done hitherto, between inspiratory and expiratory dyspnœa.

To Biermer and Gerhardt belongs chiefly the credit of having first accurately established the difference between inspiratory and expiratory dyspnœa. This difference between the inspiratory and expiratory forms of dyspnœa has had further demonstration and verification through my own graphic observations, and through the method of manometry introduced by Waldenburg [1] into clinical practice.

As Biermer suggests in his admirable work upon bronchial asthma, it is convenient to distinguish two principal forms of dyspnœa : the one, chiefly *inspiratory*, the other chiefly *expiratory* in character. The breathing in croup, in œdema of the glottis (larynx), in stenosis of the trachea, in spasm of the glottis, in paralysis of the dilators of the glottis, and so on,—in short, the breathing in any form of constriction of the larger airpassages will serve as an example of inspiratory dyspnœa. Emphysema, chronic bronchial catarrh, and bronchial asthma represent examples of expiratory dyspnœa. The difference between these two forms of dyspnœa is evident upon mere contemplation, but it becomes more distinct on graphic exploration. Here, as I have previously shown, very great differences become manifest, so that a mere inspection of the curves is sufficient to distinguish the two forms from one another, even to afford a judgment as to the severity of the inspiratory or expiratory dyspnœa.

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[1] Berlin. klin. Wochenschr., 1871, No. 45.

Of the affections just mentioned which are associated with dyspnœa, it is chiefly *spasm of the glottis* which may lead— and indeed often has led—to confusion with asthmatic seizures. The distinction between these two forms is principally based on the following points :

In spasm of the glottis, inasmuch as inspiration is chiefly impeded, all the inspiratory auxiliary forces are called into assist-ance, often with stretching of the vertebræ and bending of the head backwards, in order to raise the thorax and dilate it as much as possible. The respiration is retarded, inspiration being considerably prolonged, while expiration follows relatively easily and promptly.

This one circumstance, that the breathing appears retarded in the same manner as in asthma, though, as a matter of course, in the reverse sense, suffices to show that the very common explanation, which refers the prolongation of the breathing in croup and analogous diseases to reflex action of the superior laryngeal nerve, does not answer in every case. As Breuer [1] has shown, it is by means of the principle of self-regulation of the respiration through the vagus nerve that the different respiratory obstructions are overcome by appropriate changes in the mode of breathing. Expiration, therefore, is strengthened and prolonged in a reflex manner in impeded escape of air from the lungs ; and conversely, a stronger inspiratory activity is called into play in case of insufficient access of air to the lungs. To repeat this in other language, it is simply upon grounds of utility that the respiration is thus retarded. It has been shown for example, that the retardation never affects both phases of breathing in the same manner ; but that, in diseases of the larger air-passages associated with stenosis, and therefore, in spasm of the glottis also, inspiration appears considerably lengthened, while but little time is expended in expiration. This great prolongation of the expiratory act is an important characteristic of stenosis of the larger air-passages, just as we have shown it to be of the bron-chial asthmatic seizure. In the one case, therefore, inspiration is considerably prolonged at the expense of expiration, while in

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[1] Die Selbststeuerung der Athmung durch den N. Vagus. Sitzungsber. der k. k. Akademie der Wissensch. zu Wien, Bd. LVIII., Abth. II., Nov., 1868.

the other the expiration is prolonged at the expense of inspiration. It is therefore evident that despite the great slowness of breathing, an admirable compensating medium is furnished by this very disproportion between inspiration and expiration.

From what has been stated there could hardly be any special difficulty in distinguishing the great prolongation of inspiration attending the breathing in spasm of the glottis from the analogous prolongation of expiration attending the breathing during the paroxysm of bronchial asthma. That this distinction has not always been fully comprehended, is best evinced in the fact that the nature of asthma has been repeatedly believed to reside in a spasm of the glottis; and also in the fact that the opinion has often been expressed that bronchial asthma is always, or very frequently, attended with a spasm of the glottis. Pure bronchial asthma, on the contrary—and with this we are chiefly concerned—is always to be distinguished by the points last mentioned from spasm of the glottis and other analogous affections.

As in all diseases associated with considerable narrowing of the larger air-passages, so, in spasm of the glottis, the patient cannot introduce the necessary quantity of air into the lungs, or can do so only by means of extremely severe and slow efforts. The air in the lungs therefore becomes more rarefied than under normal conditions, at least in the severer grades of stenosis; and a necessary consequence of this is the inspiratory retraction of a larger or smaller portion of the yielding portions of the thorax. The epigastrium, the lowermost portion of the sternum, and the contiguous cartilaginous ribs are drawn in the most; so that a horizontal furrow is formed there, which disappears again in expiration. At the same time the intercostal spaces become deeper, and the clavicular fossæ sink inwards.

A further characteristic symptom of spasm of the glottis is tne great increase in the up-and-down movements of the larynx. With this there is a loud, almost hissing, stenotic sound during inspiration, often audible at a great distance; while expiration follows relatively easily and promptly.

It is unnecessary to go any farther into the symptomatic evidences of spasm of the glottis. The points mentioned, especially the greatly prolonged inspiration, in direct contradistinction to

what is observed in bronchial asthma, the relatively easy expiration, the participation of all the auxiliary, inspiratory muscles, the inspiratory retraction, and the like, will suffice to prevent the physician from confounding this form of dyspnœa with that occasioned by bronchial asthma. In bronchial asthma the following points are especially characteristic: the great extent of the full and clear pulmonic resonance on percussion, which at individual localities takes on the character of the so-called band-box tone of Biermer; the great prolongation and strengthening of the expiratory act; the sibilant rhonchi, audible at a great distance, especially during expiration; the very slight movement of the diaphragm, and the slight, or absent bulging forwards of the epigastrium during inspiration, with increased expansion of the uppermost portion of the thorax, and the like.

A further mistake may be made between bronchial asthma and that extremely rare affection, spasm of the diaphragm. The manifestations of the latter affection deviate in numerous directions from those observed in bronchial asthma, as is shown in a passing comparison of the latter with those produced by Duchenne in artificially excited diaphragmatic spasm, following faradization of the phrenic nerve in animals. Diaphragmatic spasm is observed with the greatest relative frequency in hysterical subjects. The symptoms manifested are chiefly as follows: Inspiration is relatively short, and takes place with the assistance of all the auxiliary muscles of inspiration; the thorax then remains in this inspiratory position for a few seconds, the inspiratory muscles remaining in continuous tension; and then expiration follows rapidly and powerfully. Then begins again a new, forced inspiration, and a retention of the thorax in this inspiratory position for a short time; then a short, forced expiration again, and so on. It is not necessary to go any more closely into the consideration of the further symptoms of clonic spasm of the diaphragm. The symptoms presented will suffice for the recognition of the marked difference between the two sets of manifestations.

In like manner it seems hardly possible to confound the dyspnœa occurring in consequence of *paralysis of the posterior crico-arytenoid muscles* with that observed in attacks of bron-

chial asthma. This affection, as I first accurately pointed out in an article on this subject,[1] is characterized by the above-mentioned signs of inspiratory dyspnœa; but the voice of the patient is entirely unchanged, and laryngoscopic examination shows considerable approximation of the vocal cords during respiration, so that only a very small slit remains for the passage of the air. In contradistinction to spasm of the glottis, however, this form of disease is distinguished by the gradual manner in which the manifestations of dyspnœa reach their maximum, and by the continuance of the dyspnœa, instead of its being paroxysmal, as in spasm of the glottis. Sufficient data are given in the points mentioned to avoid confounding this form of disease with bronchial asthma.

Prognosis.—Terminations.

The asthmatic paroxysm itself, no matter how alarming a character the symptoms may assume, is ordinarily without danger. Life is hardly placed in direct danger from the paroxysm itself. At the same time bronchial asthma encloses a series of dangers, in so far as, by long continuance, it not infrequently leaves consecutive diseases behind it, which in their severer grades may eventually even endanger life. *Emphysema*, especially, is one of those affections which must be regarded as a not infrequent consecutive disease of asthma; while, on the other hand, the asthmatic paroxysm not infrequently becomes superadded to emphysema already existing.

In such cases, then, a continuous dilatation of the pulmonary vesicles becomes developed out of the acute pulmonary distention, and a loss of elasticity becomes associated with it,—in short, true emphysema, with all its consecutive manifestations, such as secondary hypertrophy and dilatation of the right heart, secondary changes in the kidneys, dropsy, and the like.

Why in one case emphysema becomes developed in consequence of the frequent recurrence and prolonged duration of the attacks, while in another, notwithstanding the longer duration of the affection and the greater severity of the paroxysms, the

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[1] Berlin. klin. Wochenschr., 1872, Nos. 20 u. 21, 1873, No. 7.

patient remains completely well, so that outside of the asthmatic periods his general health exhibits no deviation from the normal standard, is a question hardly to be answered.

In other cases *chronic bronchial catarrh* remains as a consequence and residuum of frequent asthmatic attacks.

Pure nervous asthma only exceptionally exhausts itself in a few attacks. This is observed with the greatest relative frequency in children, and in the so-called hysterical asthma. In the majority of cases asthma is a very obdurate disease, which lasts for years and decades, and frequently defies the effects of all remedies. Favorable points are : youth, complete integrity of all the organs and completely free intervals, infrequent recurrence and short duration of the paroxysms. Unfavorable points, on the other hand, are : advanced age, frequent recurrence and great intensity of the paroxysms. These circumstances give occasion, not infrequently, to secondary chronic catarrh, and to pulmonary emphysema.

It is not infrequently observed that the paroxysms follow each other in a group, after which the patient is free from them for some time, when they are again repeated in a group of seizures. Such forms as these frequently lead to the consecutive manifestations mentioned.

The younger the patient, the more readily may complete recovery ensue, and the less readily do consecutive disorders become developed, inasmuch as the organism is better able to equalize the effects of the attacks during the intervals between them ; while in older subjects, in whom the forces are already more diminished, the disease is inclined to increase, and to become complicated with organic alterations of structure. According to Salter, recovery is rare after the forty-fifth year, as the disease is then continuously disposed to become worse. On the other hand, according to the same author, the disease is always curable in subjects below twenty years of age, in the absence of organic disorders. In general it may be said, as a rule, *that the hope of recovery is in inverse proportion to the duration of the disease.*

If the respiratory and circulatory organs are fully intact, the cure of asthma is possible, and, on the contrary, when it is

linked to a lesion which leads to bronchial spasm as a symptom, the latter is usually only in so far curable as is the former.

The prognosis also depends upon the fact whether the exciting cause can be discovered and can be removed. Should this be possible, the cure, as a matter of course, presents no difficulty. Cases, therefore, which are occasioned by certain odors, by certain dusts, by certain localities, offer a favorable prognosis in so far as the subject is able to withdraw himself from these influences. If, however, the cause is undiscernible, or if, when discovered, it is irremovable, the prognosis is always more or less doubtful.

Treatment.

In the treatment of asthma two main indications are to be fulfilled: firstly, to shorten the paroxysm, to ameliorate and remove it; and secondly, to prevent its recurrence. We will first describe those remedies which, according to present experience, have proved of most value during the existence of the paroxysm. During the paroxysm itself, fresh, pure air is necessary above everything else, and this may be most simply secured by opening a window. Articles of clothing, which compress too tightly the abdomen and chest, must be removed at once. It is hardly necessary to give any regulations concerning the position and attitude of the patient during the attack. Patients find out instinctively the position which best facilitates their breathing; they usually lie by preference with their heads elevated or assume the sitting posture.

Of special remedial agents, narcotics especially deserve to be preferred far above all other remedies. In accordance with the previous delineation of asthma as a spasm of the bronchial muscles with simultaneous congestion of the bronchial mucous membrane, benefit might be anticipated from the administration of narcotics; and practical experience has fully confirmed this view. Only it is necessary to give large doses of narcotic remedies, if we wish the benefit to be prompt and certain. Above all other remedies the preparations of morphia and opium deserve to be employed, and the hypodermic use of morphia is more to be recommended than its internal administration; but, as a matter

of course, the dose has to be gradually increased the more fre-
quently it is employed.

Chloral hydrate deserves to be placed in the same rank with
preparations of morphia. It may be given in doses of from
thirty to forty-five grains or more. In many cases it is of excel-
lent service. Thus Biermer [1] reports an observation in which
the alarming symptoms of the paroxysm were fully banished
within a few minutes after the administration of the chloral
hydrate. Liebreich also states that chloral hydrate was tried
by different observers, on his recommendation, and that all
their reports coincide in stating that the asthmatic symptoms
disappeared within a few minutes after its administration.
Lebert speaks rather more cautiously on this point. I have
almost always seen the paroxysm diminish considerably in
severity after the use of chloral hydrate, though, for the most
part, I have not seen it fully subside at once. This sort of
incomplete effect is readily understood, in accordance with the
theory advanced that the congestion of the mucous membrane
plays an important part outside of the spasm of the bronchial
muscles.

I must mention nitrite of amyl as a remedy newly intro-
duced into practice. Experience with this remedy is still too
scanty to permit recognition of the exact indications for its
employment. Very favorable results from its use in asthma
have been reported by individual observers. Thus Pick [2] reports
an observation of his own in which great, though very tempo-
rary, amelioration followed the administration of this remedy on
every occasion. The case was that of a physician who had
suffered from asthmatic troubles since his earliest youth, the
disease having gradually increased in the course of time, and
having resisted the collective series of remedies recommended in
asthma. Expectorants and narcotics only were competent to
afford some relief. Great relief ensued from inhalation of nitrite
of amyl, as long as the inhalation lasted, and for some little
time after. The breathing was then very deep, and accom-
plished exceedingly well. The benefit was only temporary, but

[1] L. c., p. 39.

[2] Das Amylnitrit und seine therapeutische Anwendung. Inaug.-Dissert. 1874, Bonn.

at the same time so certain that the patient always resorted to it every time he was attacked. Pick relates, in addition, two other cases of asthma, not observed by himself, in which the attack was always subdued at once by the nitrite of amyl, and in which the intervals became lengthened ; but complete recovery was not attained, so that the nitrite of amyl had but a palliative influence.

I have had frequent opportunity to test this remedy in asthma. In all the cases there was a slight decrease of the dyspnœa, slower and deeper breahting, and some subjective relief after the inhalation of a few drops of the nitrite of amyl ; but in no instance was there a complete disappearance of the paroxysm.

The preparations of belladonna and cannabis Indica have long played an important rôle in the treatment of the asthmatic paroxysm. In like manner, subcutaneous injections of atropia have been found of assistance in asthmatic attacks (Courty and Hirtz). So also inhalations of chloroform and of sulphuric ether have been repeatedly employed with good results. Bromide of potassium, too, in large doses, is sometimes competent to relieve the paroxysm to a great extent. It is less to be recommended for the purpose of cutting a paroxysm short, than to diminish the frequency and intensity of the attacks by its prolonged administration.

The old method of ordering draughts of strong Mocha, and the administration of ice pellets or small portions of frozen fruit, as especially recommended by Romberg, belong to dietetic rather than to actual medicinal treatment.

Inhalations of oil of turpentine, with or without admixture of narcotics, have been recommended by Waldenburg in mild asthmatic attacks, especially in emphysematous subjects. It may be remarked, in this connection, that inhalations can be employed only in mild asthmatic attacks ; for a long-continued inhalation is impossible with very severe dyspnœa.

Besides the remedies already mentioned, there are a great number of others which have been repeatedly recommended by this or that observer, and have proved serviceable in individual cases. We confine ourselves, her to recording the most important

of them, but must, with Trousseau, premise the remark that, like all neuroses, asthma will often be relieved by remedies of extremely different nature, according to the individuality of the case. Experiment only will reveal the proper one.

An enumeration of all the remedies with which patients often help themselves is hardly possible. Thus, just to quote an example, Trousseau relates a case in which an asthmatic subject, as often as he was attacked with asthma, lighted five or six Carcel lamps in his room, and was immediately relieved thereby. A second patient, whose attacks occurred in the day-time, jumped upon his horse and could not obtain relief until he rode incontinently at a sharp trot against the wind.

The inhalations of certain fumes and the smoking of narcotic or indifferent substances, have had very extensive employment; of these remedies *stramonium* has become most widely resorted to. In the East Indies, as related by Trousseau, smoking the leaves of the indigenous datura metel was a popular remedy. Sims, who first experimented with this remedy in Germany, endeavored to replace it with stramonium. The attempt succeeded, and thus stramonium gradually became introduced as a general remedy in asthma. Trousseau says of it, that of all remedies employed in the asthmatic paroxysm, it is ordinarily of the most service. The dried leaves are either smoked or burned in the apartment of the patient. It also frequently happens that the paroxysm may be cut short by tobacco-smoking, provided the patient is not too much accustomed to tobacco. Espic's cigarettes have long stood in special favor in the treatment of asthma; and in their composition nearly all the poisonous solanaceæ—datura, tobacco, hyoscyamus, belladonna, and the like—are used. The formula for these cigarettes is, according to Trousseau, as follows:

Belladonna leaves.....................	$5\frac{1}{2}$ grains.
Hyoscyamus leaves....................	$2\frac{3}{4}$ "
Stramonium leaves....................	$2\frac{3}{4}$ "
Leaves of *Phellandrium aquaticum*.....	1 "
Extract of opium.....................	$\frac{1}{8}$ "
Cherry-laurel water....................	q. s.

The well-dried leaves, stripped of their stems, are cut small and intimately mixed. The opium is dissolved in the cherry-laurel water, and the mass is moistened with the solution. In addition to this, the paper used for making the cigarettes is previously washed in a maceration of the plants mentioned in cherry-laurel water, and then carefully dried. The patient smokes one or two of these cigarettes during the paroxysm. When the patient cannot smoke, the stramonium leaves may be burned in his apartment. Much depends, however, upon the individual. While the stramonium helps some at once, there are others who do not obtain the slightest benefit from it. It is especially inefficacious in tobacco-smokers ; yet, on the other hand, there are some patients who, because they do not use it habitually, are able to suspend their paroxysms by smoking tobacco (Trousseau). Thus Trousseau, who suffered from asthma himself, mentions that it often sufficed for him to take a few whiffs from a cigar, to free himself from his asthmatic trouble.

The fumes of *arsenic* or of *saltpetre paper* have been recommended by many. To use the arsenic, a solution is made of fifteen grains of arsenite of potassa in half an ounce of distilled water. A sheet of unsized paper is saturated in this solution, and then thoroughly dried and divided into twenty equal parts. Each piece is then rolled into the form of a cigarette. The patient, after lighting one, lets the smoke penetrate into the bronchi by means of a slow inspiration. Not more than eight or ten inspirations should be taken, and these but once a day. The saltpetre paper is prepared in a similar manner. A piece of unsized paper is soaked in a half-saturated solution of saltpetre ; it is then divided into a certain number of small pieces, which are rolled into cigarettes. If the patient cannot smoke, the paper is rolled into a ball, which is then lighted, and covered with a funnel, or simply with a cone of paper, through the narrow end of which the smoke passes into the mouth of the patient, and is then inhaled.

Besides the remedies last mentioned, the application of ammonia to the posterior portion of the pharynx, first recommended by Ducros, has played a great part in the treatment of the asthmatic paroxysm, especially in France. Rayer and

Trousseau have seen good results from the use of this remedy in
individual cases.   In others, on the other hand, Trousseau saw
fearful paroxysms set in at the moment of the application, on
which account he took the precaution of commencing by letting
the patient inhale ammonia from a phial containing it held
under the nose, and then touched the pharynx with a weak
solution, the strength of which was then gradually increased.
The asthmatic patient may also be surrounded by an ammonia
atmosphere, by letting liquid ammonia evaporate from dishes in
the apartment.   The advice of Trousseau is good, to close the
patient's nostrils with a little cotton-wool, so as to render the
odor of the ammonia more bearable.

In accord with these therapeutic results is the fact that
many asthmatics find themselves much better in places where
ammonia is developed.   Thus Trousseau relates the example
of a sea-captain who had no trace of his malady as long as he
was aboard his guano-laden vessel, or as long as he remained on
the island where this material is obtained.

Finally, *emetics* have been extolled by some authors as effi-
cacious in aborting the asthmatic attack.   Lebert recommends
the use of an emetic of ipecacuanha, especially in severe, ob-
stinate, and protracted cases.   Seitz also praises emetics in
such cases, but especially recommends the administration of
nauseating doses of tartar emetic or ipecacuanha instead of
doses sufficient to produce vomiting.   The otherwise so effica-
cious muriate of apomorphia is not so well adapted to these
cases, as it is a nauseant influence that is required rather
than emesis.   At all events, however, the use of emetics does
not seem to be indicated, except in cases in which the majority
of the remedies enumerated, especially the most valuable ones,
have proven to be useless.

Inhalations of oxygen have been repeatedly recommended
in asthma.   Whether strychnia, from which Störck observed
temporary benefit in a few cases, is of important service, further
trials must decide.   With reference to the coexisting congestion
of the bronchial mucous membrane, ergotine deserves trial, espe-
cially by hypodermic injection.

Rarefaction of the air during expiration also deserves to be

tried; but this method is not practicable in severe cases of dyspnœa. I have not seen any striking results from this treatment, as far as regards cutting the paroxysm short.

We must refrain from enumerating further remedies which have been occasionally found serviceable in this or that case. As already mentioned in our introduction, the remark applies here that no general rule can be presented applicable to every case.

In the second place, the treatment to be carried out between the paroxysms comes under consideration. In other words, there is an indication to prevent the recurrence of the paroxysm. To this end, it is of especial importance to avoid or remove, when possible, those sources of injury which the patient knows to have produced previous attacks, or which have favored their occurrence. Thus, to give an example, the attack, in some patients, has a certain relation to darkness. Such patients, therefore, must burn a light during the night. As a rule, the patient is himself mindful of these particulars.

In many cases the asthma is occasioned by pregnancy, and then disappears spontaneously after the subsequent confinement.

In other cases, as observed especially by Voltolini,[1] and more recently by Haenisch,[2] the asthma is associated with nasal and naso-pharyngeal polyps. Here, as a matter of course, the first indication is to remove them. Voltolini and Haenisch report observations of this kind, in which the asthmatic attacks disappeared with the removal of the polyps, and recurred with their fresh reappearance; so that a direct relation between the polyps and the occurrence of the asthmatic attacks was established beyond a doubt.

Among the medicaments which are calculated to prevent the recurrence of the paroxysms, and thus to cure the asthma completely, arsenic deserves the most prominent mention. It is most frequently employed in the form of Fowler's solution (three or four drops three times a day). Lebert recommends, in obstinate cases, a combination of quinine with arsenic and atropia, as in

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[1] Die Anwendung der Galvanokaustik im Innern des Kehlkopfs und Schlundkopfs, u. s. w., 2 Aufl., 1872, p. 246 et seq.

[2] Berliner klin. Wochenschrift, 1874, No. 40.

the following formula : muriate of quinia, sixty grains ; arseni-
ous acid, one grain ; atropine, half a grain ; extract of gentian,
sixty grains; mix, and make into sixty pills. At first one pill is
given daily ; after a few days, two daily ; and the quantity is
gradually increased to four pills in the twenty-four hours, or
even to two pills three times a day.

In that form of asthma, especially, described as occurring in
a certain, though not well explained interchange with cutaneous
eruptions—the form designated as herpetic asthma by Walden-
burg—arsenic has been repeatedly found serviceable. Fowler's
solution has also been repeatedly employed by inhalation, with
very good results (Eck, Wistinghausen, Waldenburg). In like
manner, its employment by subcutaneous injection is to be rec-
ommended.

Tincture of lobelia must be mentioned as a remedy formerly
much praised, though less employed at the present day. It is
given in doses of from ten to thirty drops, and as often as three
times a day. Lebert has seen good results from its use in sev-
eral cases ; but he reports, in addition, that not only is its effect
temporary, but that it loses its efficacy with time ; so that it
eventually becomes wholly useless, even with variation in the
dose and mode of administration.

Trousseau recommends the following complex method of
treatment, continued for a long time :

1st. For ten successive days in the month, the patient is to
take at bedtime, at first one, after three days two, and the last
four days four pills, each containing one-sixth of a grain of
extract of belladonna and the same quantity of powdered bella-
donna root ; or else one, two, and finally four granules of atro-
pine, each containing one sixty-fourth of a grain.

2d. The ten following days the belladonna preparation is to
be superseded by syrup of turpentine (a tablespoonful three
times a day), or better, by three capsules of oil of turpentine.

3d. During the last ten days of the month the patient is to
smoke arsenical cigarettes.

Finally, in addition, every tenth day the patient is to take in
the morning, on an empty stomach, sixty grains of powdered
calisaya bark in black coffee.

Trousseau claims to have seen great benefit from this method of treatment in a certain number of cases.

Waldenburg recommends, in the asthma of emphysematous subjects, the smoking of saltpetre and inhalations of oil of turpentine every evening; and he has observed freedom from paroxysm for many months follow the treatment; although complete recovery has ensued only in the rarest instances.

Quinine has been found to be serviceable in many cases (from one and a half to three grains twice a day). The shorter, and especially the more uniform the intervals which elapse between the paroxysms, the more can something be expected from quinine (Seitz).

Besides the remedies cited, some metallic nervines deserve mention, especially oxide of zinc, nitrate of silver, and pills of carbonate of iron. Bromide of potassium, too, is worth trial in many cases. On the other hand, hardly any special benefit is to be anticipated from castor, camphor, assafœtida, tincture of valerian, and similar remedies likewise recommended by individual authors.

Sublimed sulphur has been recommended by Duclos as a "therapeutic agent of infinite efficacy" against the recurrence of asthmatic paroxysms. Sulphur baths have been praised by Courtin, Lebert, and others.

Finally, we have to mention the secret remedy of Aubrée as one of the most noted remedies. The formula for this remedy is, according to Trousseau, as follows:

Seneka root............................... 30 grains.

Make a decoction with 4 fluid ounces of water; then add—

Iodide of potassium............... 231 grains.
Syrup of opium [1]................. 4 fluid ounces.
Brandy...................... ..... 2 fluid ounces.
Tincture of cochineal............. enough to color.
  Filter.

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[1] Extract of opium, 1 part: dissolve in a small quantity of genuine white wine, and mix with simple syrup, 1,000 parts.—*German Ph.*

The patient is to take three tablespoonfuls of this elixir daily until the asthma has entirely disappeared.

According to Roth,[1] who likewise reports good results from the use of Aubrée's mixture, its actual composition is as follows:

Lactucarium......................	9 grains.
Iodide of potassium...............	77 grains.
Spirit of chloric ether [2]............	18 minims.
Water.........................	5 fluid ounces.
Syrup	1 fluid ounce.

One-sixth part at a dose.

Similar good results have been reported by several other authors who have experimented with Aubrée's secret remedy. Others again have found no benefit follow even a prolonged use of it. The good effects of this remedy seem to reside solely in the iodide of potassium which has long been recommended in asthma. Even at the present day iodide of potassium is recommended by many physicians, and frequently resorted to. My own experience is not much in favor of its great efficacy.

Finally, the treatment suggested by Leyden is worthy of mention, though further experience has not yet been reported. As previously stated, we are indebted to Leyden for evidence of the existence of peculiar crystals in the sputa of asthmatic subjects, which he believes to have a certain relation with the occurrence of the paroxysms. The idea of dissolving these crystals by substances administered by inhalation naturally suggested itself. Leyden, on account of their ready solubility in alkalies, tried inhalations of table salt and carbonate of soda, of each one part in the hundred, twice daily. These inhalations appeared to be of service.

That the constitution of the patient must be taken into careful consideration in the treatment of asthma, is self-evident. Thus, for example, the preparations of iron, residence in the country, and the like, are to be ordered for chlorotic girls and

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[1] Deutsches Archiv f. klin. Med., Bd. VII., p. 453.

[2] An officinal of the German Pharmacopœia, obtained by distilling a mixture of 6 parts of crude hydrochloric acid and 24 parts of alcohol from black oxide of manganese. The distillate is neutralized by slaked lime and redistilled.

anæmic patients. If there be chronic bronchial catarrh, the remedies employed for this affection, especially the expectorants, the alkaline mineral waters, and the like, are to be resorted to.

The employment of rarefied air in expiration, and condensed air in inspiration, has proved an especially effective remedy, particularly in cases associated with chronic bronchial catarrh or emphysema. Not long ago it was usually necessary to send patients to some remote locality, inasmuch as the so-called pneumatic cabinets were to be found in but few places. Recently the employment of compressed and rarefied air has been greatly facilitated by the construction of portable pneumatic apparatus, as first devised by Hauke.[1] The favorable action of this remedy in catarrhs and emphysema complicated with asthma is easily comprehended.

In contrast to the pneumatic cabinets in which the entire body of the patient is placed, so that he not only inspires compressed air, but must perform the expiratory act in it also, and in which, furthermore, the compressed air not only acts upon the interior surface of the lungs, but at the same time upon the exterior of the chest also, as well as upon the entire exterior surface of the body, we are enabled by means of portable pneumatic apparatus, to allow the increased pressure to act upon the interior surface of the lung only.

It is to be especially recommended, on principles readily comprehended, to permit such patients—emphysematous subjects particularly—to breathe into rarefied air, and this is quite feasible with the apparatus last mentioned, especially that devised by Waldenburg, which has become widely known, inasmuch as inspiration of condensed air and expiration into rarefied air may be performed alternately.

Where, therefore, the bronchial asthma is in intimate association with emphysema and chronic catarrh, but also without this association, in pure idiopathic asthma, the method of employing compressed and rarefied air is much to be recommended, as at least a portion of the difficulty can be removed, and the asthma

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[1] Ein Apparat zur künstlichen Respiration und dessen Anwendung zu Heilzwecken. Wien, 1870.

be thus far relieved. In several cases of idiopathic asthma I have seen the paroxysm markedly diminished in severity and frequency under the long-continued exclusive use of rarefied air in expiration.

In cases in which the procedures mentioned are incapable of curing or relieving the malady, nothing else remains but to try a change of residence. In making a choice the adviser must be guided by the personal experience of the patient. There is no absolute rule in this respect. The same locality which prevents the paroxysm in one patient, may not have the slightest influence in the case of another.

DISEASES OF THE PLEURA.

FRAENTZEL.

DISEASES OF THE PLEURA.

PLEURITIS.

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History.

INFLAMMATIONS of the pleura, whether of the pleura costalis or of the pleura pulmonalis, we are in the habit of calling pleurisy, or generally nowadays pleuritis. The term *pleuritis* dates from a period anterior to that of Hippocrates. By it was meant a feverish affection of the respiratory organs, accompanied with "a stitch in the side," without its being quite clear what was the precise seat of the disease, or to which organ it was limited. Diocles, Erasistratus, Asclepiades, and others localized the disease in the pleura alone; whereas Euriphon, Evenor. Praxagoras, Philotimus, Herophilus, and their disciples[1] looked upon the lungs as the part affected, while they regarded the pleura costalis and the intercostal muscles as the seat of the pain.

Already in the Hippocratic writings, pleuritis is distinguished from peripneumonia, and is divided, according to its seat, its causes, and its symptoms, into pleuritis ascendens, descendens, posterior, anterior, sanguinea, biliosa, pituitosa, melancholica, and finally into pleuritis sicca and humida. Galen also speaks

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[1] Vide Cælius Aurelianus, l. c.

of pleuritis in contradistinction to pneumonia and peripneumonia. Yet writers of later date have always taken a more or less wavering position as to the seat of pleuritis, and accordingly Sydenham, Boerhaave, van Swieten, Haller, Morgagni, de Haen, and others have always in their writings returned to this question, and of these Haller and Morgagni still defended the view that in pleuritis the lungs are always affected as well as the pleura.

Pinel was the first to place pleuritis definitely amongst the inflammations of serous membranes, and since then it has been regarded nosographically as an independent disease.

Its anatomical and pathological relations, as well as its diagnostic signs, were first made known to us more accurately by Laënnec, and it is on the foundation of his systematic observations that the pathology of pleurisy has attained greater and greater development. Many of his views have since been proved to be erroneous, many have been greatly extended, many new facts have been recently investigated; but we must still acknowledge, as well to-day as fifty years ago, that the foundation of our present pathology and treatment of pleuritis was laid by Laënnec. It has, however, been reserved for the last ten years to mark an epoch in the treatment of pleurisy by chronicling advances which can scarcely be claimed for any other malady.

In this particular direction we may look with justifiable pride on the results which our improved methods of treatment have enabled us to place on record, and may point to recoveries from severe illnesses which, according to former notions, were to a great extent incurable.

Etiology.

Pleuritis may either occur as an independent primary disease in persons previously healthy, or it may arise in the course of other maladies, and then, most frequently, as secondary to other affections of the respiratory organs.

We are often unable to point to the cause of an attack of primary pleurisy, though we frequently find that it has arisen from direct exposure to cold.

In contradiction to the view widely spread in hand-books, and held by many private practitioners, that it is only theoretically, and not from practical observation, that cold can be asserted to be a cause of primary pleurisy, I can positively maintain that a very careful examination of my own experience would enable me to bring forward many proofs in favor of this view.

For example, even imperfectly educated hospital patients have frequently assured me, in the most decided manner, that they had, when heated, undressed and exposed themselves to draughts on that side which subsequently became affected; or that, having been wetted through by a cold shower of rain, the side attacked was that which had been exposed to the wind; and I could mention many other cases like these. It is constantly stated that sitting at an open window, or near a badly closing door, especially when the room has been warm and the outer air very cold, caused the illness; that in this way pain immediately arose in the affected side, and increased gradually until the attack became fully developed. Persons recovering from severe illnesses, and individuals who are under the influence of active medicinal agents, are most prone to succumb to such causes of disease. Men, for example, who are going through a course of mercury or iodine, readily become the subjects of pleuritis from very slight exposure to cold. Frequently, however, we fail to find any tangible causal condition to which we can refer the origin of the illness.

When pleurisy arises in consequence of an injury to the chest, as from severe contusions and such like, without any external wound or evidence of fracture of the ribs, it is usual to call this a *primary traumatic pleuritis;* if, however, there should be, at the same time, great laceration of the soft parts, or a fracture of one or more ribs, or when, in consequence of the injury, blood or pus or any foreign body has found its way into the pleural cavity, the inflammation thus excited is termed *secondary traumatic pleuritis.* Cases of the latter kind are usually complicated by the entrance of air into the pleural cavity.

Thus traumatic pleurisies form, in a manner, the transition between the primary and secondary affections. The last are

incomparably more frequent than the first, since the greater number of affections of the lung-tissue lead secondarily to changes in the pleura ; either the inflammatory process extending directly from the lung to the pleura pulmonalis, or, from their close adjacency, the lung and the pleura becoming attacked simultaneously.

Thus we always find fibroid pneumonia associated with pleurisy as pleuro-pneumonia, even when the inflammation of the lung-tissue itself does not reach the pleura pulmonalis. Indeed in such cases the pneumonia is frequently the subordinate affection, while the pleuritis assumes a dangerous character. These are the cases of pneumo-pleuritis, or peri-pneumonia, concerning which a number of important and valuable observations have already been recorded in the Hippocratic writings ; and the pathological relations of which it has been the merit of modern times, and especially that of Traube, to estimate accurately. Caseous pneumonia goes really hand in hand with inflammation of the pleura. This is sometimes quite circumscribed, and leads to adhesion of the pleural layers at the affected spot ; sometimes it is diffused over a great part of the pleura, and it is then not infrequently associated with a considerable outpouring of different kinds of effusions. Catarrhal pneumonia rarely occurs without secondary pleuritis. Even feverish bronchial catarrhs, especially when they are accompanied by violent and protracted fits of coughing, lead frequently to a similar complication. The same may be said of hemorrhagic infarctions, as these generally reach as far as the pleura pulmonalis, and of gangrene of the lung, especially when it appears as the consequence of numerous infective emboli, collected in different small groups. For these also are spread in wedge-like masses, regularly, as far as the surface of the lung, and there they excite a pleuritis which commonly leads to extensive purulent exudation ; or the gangrenous mass may perforate the pleural cavity and give rise to a pyopneumothorax. These inflammations of the pleura, which are of especially frequent occurrence in cases of so-called pyæmia, are regarded by many physicians of the present day as linked together as a general blood disease.

It would lead us too far if we were to attempt to examine in

detail all the possible conditions under which a secondary pleu-
ritis may arise as a consequence of inflammatory affections of the
respiratory organs.   One remark must, however, be made, viz.,
that a circumscribed inflammation of the pleura may itself lead
to secondary pleuritis, as, for instance, when from the part
originally affected the disease spreads wider and wider around
it ; or when a limited inflammation of the upper part of the
pleura is attended with liquid exudation, and this collecting in
the lower part of the pleural sac, acts there as an exciter of
inflammation.   Small purulent or sanious effusions are especially
prone to spread the inflammation in this way.   The same result
follows when, from any cause whatever, the pleura becomes per-
forated at one spot, and air is thus admitted into the pleural
cavity ; when, in short, a pneumothorax has been produced,
then either the contents of the bronchial tubes, or a necrosed
portion of pleura, or a particle of gangrenous lung-tissue, or,
finally, the air itself, if it contains infective germs,—either of
these, by entering the pleural cavity, may excite inflammation
there.   We must also clearly understand that pleuritis may be
produced by an extension of disease from any of the organs
adjacent to the pleura costalis ; and, conversely, pleuritis itself
may induce inflammation of neighboring tissues and organs, so
that in many cases it may be difficult to decide which form of
disease is secondary and which primary.   Thus pleuritis some-
times accompanies pericarditis, and sometimes abscesses under
the pleura costalis, whether these be produced by purulent peri-
pleuritis or by caries of a rib or a vertebra.   Diffuse peritonitis
is often complicated with pleurisy, the inflammatory process
extending from the peritoneum to the pleura, through the dia-
phragm, by means of the serous canaliculi described by von
Recklinghausen.   This complication is frequently seen to occur
in puerperal peritonitis, and then almost invariably leads rapidly
to a fatal issue.   So also from abscess of the liver, by means of
the same canals, pleuritis may be set up, without the diaphragm
itself being widely implicated.   Much more rarely it arises from
other disorders of the digestive organs, as, to take the most com-
mon instance, when cancer of the œsophagus directly invades
the pleura.   We have learned during the repeated epidemics of

relapsing fever,[1] which have of late years prevailed in Berlin, from post-mortem examinations,[2] that abscess of the spleen is a comparatively frequent complication of this disease, and that by the passage of purulent masses through the lymph channels of the diaphragm into the pleural cavity a purulent inflammation may be set up therein.

Finally, secondary pleurisy may occur as a complication of other diseases which cannot be proved to have any direct connection with the pleura. Many authors refuse to recognize these cases as secondary affections, but they are wrong, for the pleuritic complication follows so frequently, and without any other evident cause, that we are forced to regard it as a complication peculiar to the disease to which we find it so generally consequent. This is especially the case with rheumatic polyarthritis, when, besides the affection of the different joints, the pleura, the endocardium, and the pericardium often become the seat of inflammation. Although Richardson's theory, that lactic acid is discharged from the blood into the joints, the pleura, the pericardium, and elsewhere, and, acting as an irritating material, excites inflammation therein, falls to the ground for want of sufficiently convincing experiments, yet we are compelled to admit, on various other grounds, among which I will only mention the peculiarly favorable results which have followed Davies's method of treatment as reported to us by Traube,[3] that in fact an irritating material does exist in the blood in these cases, and that when this is discharged into the pleura it excites secondary pleuritis. The same may be said with regard to gout, in the course of which attacks of pleurisy are common. And I would include scarlet fever in the same category, since joint affections and inflammation of the pleura are commonly secondary to it. The pleurisies which very commonly appear in the course of chronic renal disease are often reckoned amongst these, but in a great number of cases this view is erroneous. For it must be remembered that patients who suffer from chronic renal disease are hydræmic, and like persons who are taking mercury or

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[1] See page 258 of Vol I. of this Cyclopædia.

[2] *Ponfick*, Virchow's Archiv, LX., p. 128 et seq.

[3] Verhandl. d. Berl. med. Gesellsch., 1865.

iodine, or who from any other cause have become cachectic, are especially prone to become the victims of inflammatory affections, which are then erroneously regarded as peculiar to the renal disease.   On the other hand, a serous effusion into the pleural cavity may occur as a part of that general dropsy to which patients with renal disease are subject, and, like hydrothorax from other causes, it may, without any discoverable reason, assume an inflammatory character.   Nevertheless the view is not to be wholly rejected that in individual cases renal disease, as such, may produce secondary pleuritis ; and it does so, apparently, by the retention in the body of those solid constituents which should be eliminated in the urine, and which are in this case discharged into the pleural sac.   As a further confirmation of this view we might cite the fact, which every tolerably experienced hospital physician must have often observed, that in these patients diffused peritonitis (the rheumatic origin of which we have long considered to be set aside) occurs independently of ordinary exciting causes, and rapidly leads to a fatal termination.   In this case we are at all events forced to admit that, in consequence of the renal disease, irritating matters have been retained in the blood, and having been discharged into the peritoneal sac have there acted as exciters of inflammation.   This irritating matter we believe to be urea, and we speak of *uræmic peritonitis*, though no actual proof has hitherto been furnished that a secretion of urea is the cause of it. An analogous instance to this is, however, afforded by the secretion of urea through the skin.   We cannot, therefore, reject the hypothesis that, when a patient with renal disease becomes, without any other evident cause, and coincidently with a diminution of the renal secretion, suddenly attacked with one-sided pleurisy, it should be regarded as a secondary affection to the renal disease.

The fact deserves to be prominently mentioned, as opposed to the experience that different diseases are frequently complicated with secondary pleuritis, that in typhoid fever, in the first weeks, whilst the fever has still the type of a continued-remittent, and in which the morning remissions do not fall below a temperature of 102° F., the occurrence of pleuritis as a complica-

tion is extremely rare, so that the development of a secondary pleurisy in this stage of typhoid fever is almost excluded. I wish to lay especial stress on this statement, because by firmly holding to this view—previously taught by the older physicians—I was, even in the time when I first began to practice in connection with medical charities, repeatedly, in many well-remembered cases, preserved from gross blundering. But, strange to say, it has, on the other hand, been unhesitatingly maintained by some authors that pleurisy is a frequent secondary affection in typhoid fever. If the fever of typhoid assumes a hectic form, that is to say, if the morning temperature is normal or sub-normal, while the evening temperature is still high, and especially if there has been exposure to cold, an attack of pleurisy may supervene.

It may happen very frequently to convalescents from typhoid fever, as indeed to all convalescents, to be attacked by pleurisy, but this naturally would not be regarded as a secondary affection of the original illness.

Age and sex may be disregarded in connection with the greater number of cases of pleurisy. The old opinion, that very young children are not attacked by pleurisy, still finds support in the assertion of Barrier, that this disease is never observed in children under six years of age. It is true that diagnosis in children of tender years is difficult, but improvements in our diagnostic methods have had the effect of dissipating the idea that young children enjoy an immunity from pleuritis.

Guinier, of Montpellier, punctured an empyema in a child twelve months old, and Ziemssen tabulated fifty-four of his young patients who suffered from pleurisy, and of these 3 were one year old, 1 two, 7 three, 4 four, 2 five, 4 six, 4 seven, 5 eight, 9 nine, 7 ten, 2 eleven, 1 twelve, 1 thirteen, 2 fourteen, 1 fifteen, and 1 sixteen years old.

The male sex suffer most from primary pleurisy in youth and early manhood, because they are most exposed to injurious atmospheric influences, and to accidental wounds. To the same causes may be referred the prevalence, in Berlin at least, of primary pleurisies during the winter months. I should mention here, as a result of my experience, that I have seen pleurisies, especially with extensive exudations, much more frequently on the left side than on the right.

Pathology.

Various Forms, and General Course of Pleuritis.

Pleuritis presents itself in very different forms. It may be limited to a small portion of the pleura, or it may be spread over the greater part of it. It may be attended with a large or a small amount of effusion into the pleural sac, or with none at all. It may differ also in the nature of the fluid effused, and finally, it varies according to the rapidity of its course. We are therefore in the habit of speaking of circumscribed pleurisy, or *pleuritis circumscripta*, as contradistinguished from the more common form of pleurisy, which is, as a rule, spread over a wider tract of pleura. A circumscribed pleuritis, as its name implies, runs its course without any noteworthy effusion of fluid ; we therefore call it dry or fibrous pleurisy—*pleuritis sicca*, or *fibrinosa*.

We cannot, usually, in the first days of the illness, draw an distinction from the nature of the exudation which has been poured out. It is only later in its course, when special symptoms become prominent or strikingly developed, that we can draw any further conclusions as to the nature of the fluid effused, and then, grounded on these symptoms, we may be able to distinguish the different forms of the disease from one another. Any effort to make this distinction at the beginning is met by great difficulties.

Even the separation of pleuritis, according to its course, into an *acute* and a *chronic* form, bears, as Wintrich very justly remarks, more the character of conventional usage than the mark of a true distinction, indicated by nature itself. In fact, speaking anatomically, chronic pleuritis often presents many more intense signs of inflammation than the acute form ; and, clinically, we very often see an acute pleurisy become chronic, and quite as often a chronic pleurisy return to the acute stage, whether it had, in the first instance, an acute form or not.

If the local symptoms of inflammation, as well as the feverish manifestations, last only a short time, and if the exudative deposit is absorbed in a few weeks, the pleuritis is termed *acute*.

Slight attacks of pleurisy, which we know from experience frequently lead to adhesions, may apparently run their course without any subjective symptoms, or these are so slight that they pass unobserved by many persons who are not accustomed to pay particular attention to their bodily sensations. At least, we often find more or less extensive pleuritic adhesions in the case of people who, apparently, have never been ill. On the other hand, quite slight attacks of circumscribed pleuritis, in which merely fibrinous exudation occurs between the pleural layers over a very limited portion, may produce, among persons who carefully regard their sensations, a feeling of oppression or even of pain in the part affected. Such persons often complain, in addition to a dull feeling of oppression, of a certain dragging feeling on deep inspiration, or when they sneeze, yawn, etc. ; on questioning them more closely, they will admit that they experience a certain amount of dyspnœa on going upstairs and in other fatiguing exercises. On looking at the affected side it always appears a little retracted ; percussion rarely affords us any information ; but on auscultation we may almost always hear a friction sound, though it may be confined to a very circumscribed area. According to my experience, therefore, I must decidedly object to the view maintained in many handbooks, that these cases of circumscribed pleuritis run their course without objective symptoms. Should the disease be somewhat more widely spread, then it is accompanied with all the signs of fever ; there is some shortness of breath as well as cough ; and on the affected side, where the friction sound is not heard, the vesicular breathing is weaker than on the sound side.

A more severe attack of pleurisy, with a greater amount of fibrino-serous exudation—a frequent consequence of exposure to great cold—is sometimes ushered in by an intense rigor, which may recur, with less severity, during the course of the illness. The rigor is succeeded by a feeling of heat, by thirst, and by more or less prostration. Commonly, before, during, or immediately after the shivering fit, pains are felt in the affected side, and these, contrasting with the milder forms, assume a stabbing and sometimes a tearing or dragging character. During the first eight days this pain forms the chief complaint of

the patient, the fever continuing at a considerable height. Most cases of acute pleuritis do not begin with an initial rigor, but the temperature rises gradually.

If the course of the illness is very acute, it is accompanied with high fever. The morning and evening temperatures rise to above 104° F., and the pulse to 120 or higher ; the skin is dry and burning hot to the touch ; there is entire loss of appetite and increasing thirst ; frequently in the case of children, and sometimes with adults, there is slight disturbance of the sensorium ; the urine is scanty and very high colored.

In a few very rare cases, which are accurately designated as *pleuritis acutissima*, the attack comes on, in previously healthy people, with a severe rigor, the beginning of an evident typhoid state ; the skin is burning hot and dry, the temperature keeps over 104° F. ; there is great disturbance of the sensorium, often violent delirium ; the tongue becomes dry and fissured, the thirst is excessive, the appetite wholly fails ; the anterior extremity of the spleen, even in the early days, can be distinctly felt, and diarrhœa may set in at this time. When we first see such patients, we are all the more inclined to believe that we have to do with a case of typhoid, since the patient is unable to give us any account of himself. If, however, we learn from the attendants that the illness began with a severe shivering fit, that it has only existed for a few days, while, at the same time, we notice the absence of any rose-rash, the constant abnormal elevation of the pulse to 120 and over, the deeply cyanosed complexion, and if by physical examination we discover signs of pleuritic effusion, we must set aside the idea of typhoid and regard the case as one of *pleuritis acutissima*.

The progress of such a case is altogether "*foudroyant*." There is continued high temperature, as well as great frequency of pulse and respiration. A temperature of above 106° F., a pulse of 140, and respirations 60 in the minute may be observed ; the exudation increases during the first eight days to such an extent, and is attended with such alarming dyspnœa, and intense pain in the side affected, that puncture of the chest is urgently called for in order to preserve life. By this means a quantity of pure, thickish pus is allowed to escape. But this is not attended

with any remission in the course of the disease, for on the very next day we may find as great an amount of exudation as before. If we puncture again, the patient, after supporting the operation but a few times, sinks at the end of the second week ; and if we do not puncture, death ensues more rapidly from suffocation. On one occasion I determined, after the second ineffectual puncture on the tenth day of the illness, to proceed to the radical operation of incision into the pleural cavity, but the young patient died on the fourteenth day, of acute ichorization (Verjauchung) of the pleural sac. This operation was performed in the year 1868, at a time, therefore, when operative procedure in these cases had not revealed the perfection which it has recently attained. It must, on that account, remain doubtful whether the unfavorable result did not depend on the imperfection of the treatment. Cases of pleuritis acutissima are, however, extremely rare,[1] so that I have not had another case of that kind under my care since, and I have not been able therefore to form any opinion as to the success of our latest therapeutic methods in such cases.

Acute pleuritis generally runs a less stormy course. There is a moderate amount of fever, increased frequency of pulse, dyspnœa, pain in the affected side, loss of appetite, great prostration, so that by the end of the first week the patient is compelled to remain altogether in bed ; while during the first eight to twenty-eight days more or less effusion is poured out into the pleural cavity. The fever begins to subside when effusion takes place, and as the fever disappears the effusion becomes gradually absorbed, and with the disappearance of the exudation there is usually an increase in the secretion of urine. In the most favorable cases from fourteen to twenty-eight days may suffice for this, but, as a rule, it is some months before the patient is restored to his usual health.

If the effusion is not absorbed, the fever may disappear for a time, but there is a steady loss of strength, and commonly some complication arises which, after an illness of variable dura-

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[1] I have hitherto observed three cases only of this kind, and my attention was directed to the peculiar course of the first of these as long ago as the year 1860, by Traube.

tion, leads to a fatal issue. Should the exudation assume a purulent character, this is often indicated, at a very early period, by the presence of unusually high fever, intense pain, and manifest œdema of the subcutaneous tissue on the affected side.

After some time, generally from two to six weeks, the fever assumes quite an intermittent character, the morning temperature being always normal or subnormal, while the evening temperature is much higher. During this hectic fever the patient loses strength continuously, and if left to himself will, sooner or later, sink from exhaustion, unless the empyema bursts into the lungs, and is discharged through the bronchi, or finds its way to the surface through the pleura costalis and the soft parts of the wall of the chest, the latter forming the so-called *empyema necessitatis*. Recovery, though it rarely occurs, is certainly possible in both these cases, but not till after many months or years. Should the pus discharge itself in any other way, the patient is irrecoverably lost. We shall deal with this subject again further on, and enter into more circumstantial details.

Often in the first week of the illness, a circumstance may occur which calls for our special attention. The patient is observed to present a remarkable pallor, accompanied with rapid loss of strength, high fever, and a considerable degree of pain in the side affected. This should lead us to conclude that a hemorrhagic exudation has taken place. And this, in young people, must be regarded as the product of a *tubercular pleuritis*. In old people it may occur without any tubercular disease, but in that case it has a very great tendency to become purulent.

If, therefore, the symptoms clearly point to the occurrence of a hemorrhagic effusion, we must, of course, be prepared for the worst results. For should the case be one of tubercular pleuritis, which has culminated in a hemorrhagic exudation into the pleural cavity, although in very rare instances the effusion may be partially absorbed, yet, seeing that this occurs in lungs already diseased, it usually has the effect of hastening the already anticipated fatal issue, either by the compression of hitherto permeable portions of the lung, or by the rapid advance of pulmonary collapse, or in some other way.

Double-sided pleurisy, even when it appears to occur idio-pathically, is really always of tubercular origin. It rarely, however, of itself, reaches a development to threaten life, but, for the most part, must be looked upon as a serious complica-tion of an already more or less advanced lung disease.

Diaphragmatic pleuritis is the disease of which a very expres-sive general description has been given by the ancient physicians, under the name of *paraphrenitis*, and which has been adopted in a slightly altered form by Andral. According to this author, it is evidenced by a pain in the right or left hypochondriac region, about the cartilages of the false ribs, at the level of the dia-phragm. This pain may extend to the epigastrium and beyond it. The respirations are short and quick, the inspiratory expan-sion is confined to the upper ribs, the body is inclined forwards, the expression of the countenance is much altered, and exhibits occasional twitchings, especially about the lips. It is sometimes accompanied by hiccough, nausea, and even actual vomiting. The *risus sardonicus* described by Boerhaave, van Sweiten, and others, has not been noticed by Andral and the later physi-cians, certainly not by those of recent date.

The group of symptoms here enumerated are not, as Win-trich has stated, characteristic of diaphragmatic pleurisy, since they may be produced by inflammation of one or more of the organs lying in the upper part of the abdominal cavity, nor are they constant, for there are cases of diaphragmatic pleurisy which run their course without one or other of these characteris-tic signs.

Anatomical Changes.

We have abundant opportunity, in the post-mortem theatre, of observing the anatomical changes which accompany the various stages of pleuritis. Hand in hand with these direct anatomico-pathological observations many experiments have been made, formerly by Haller and Sarcone, and more recently by Gendrin, Andral, Guérin, Cruveilhier, Hasse, Canstatt, Paoli, and Wintrich, which have had the effect of contributing to the greater accuracy of our knowledge of the anatomical conditions which attend inflammations of the pleura.

In commencing pleuritis the first change observed is an injected condition of the blood-vessels of the subserous connective tissue, while fine red points, or streaks, caused by engorgement of separate capillary vessels, are scattered over the pleura itself. Besides this distention of the vessels, small extravasations of blood may be seen on the pleura, and in the subjacent connective tissue, so that the whole pleura has the appearance of being sprinkled over with red spots.

The color varies in intensity from dark rose color to cherry-red, or even to brown. If there has been more or less of inflammatory exudation, this leads to a diminution of the vascular injection, but the extravasations remain for a long time unchanged. The pleura then appears variously speckled and streaked with red. Later, this redness of the serous membrane very often disappears under the membranous layers of fibrine which are thrown out on its surface.

At and around the injected parts the pleura very soon looks dull, and loses its glossiness, transparency, and smoothness. It becomes dull and thickened, and its inner surface has a rough, felt-like appearance. The epithelial cells are early cast off in great abundance, and where they are still adherent they become more or less turbid, swollen, and partly filled with granular contents. The subserous tissue is infiltrated and swollen with fluid, and sometimes, at a very early period, it contains pus corpuscles.

The lymphatics in the neighborhood of the inflamed pleura are always dilated, and, according to the observations of E. Wagner, contain generally a clear fluid, poor in corpuscles.

The changes here described are always accompanied by an outpouring of exudation on the surface of the pleura, composed of serous fluid, of fibrine, and of cells ; this may be sometimes so small in quantity as to be quite unimportant, at other times it reaches an enormous extent.

In the so-called *dry* or *adhesive pleurisy*, the exudation is chiefly fibrinous ; detached cellular elements are also present, but the quantity of serous effusion is exceeding small. Sometimes quite early, sometimes later, the serous membrane becomes rougher and more felt-like, and a fibrous layer of a yellow,

grayish, or reddish-gray color, sometimes forming a hardly perceptible film, but sometimes several lines in thickness, makes its appearance, as a separable membrane on the free surface of the pleura. The pleura then appears in some cases pretty smooth, in others it has a villous, or hairy, or areolar surface. Rokitansky [1] compares it sometimes to sand-waves (Sandwellen), sometimes to the dorsal surface of an ox's tongue.

If the secretion of fibrine is more abundant, it is either at once thrown off in the form of large flakes or masses, or it lies like a soft, flaky coating on the inner surface of the original false membrane. Should there be an accumulation of serous effusion, as well as an abundant exudation of fibrine, then either the serum is retained in the large meshes of the fibrinous material, or the fibrine swims about in the form of flakes in the serous fluid. It is still uncertain what is the precise source of the fibrinous exudation in all these cases. Some regard it as directly separated from the blood, others believe that it is formed in the parenchyma of the serous membrane itself, and this latter view is, in my opinion, the more probable one.

We have next to consider what further anatomical changes take place when the pleuritis has resulted in a more or less exclusively fibrinous exudation. In the slighter cases the fibrine may undergo fatty metamorphosis, become absorbed, and thus all trace of inflammation may disappear.

Should the inflammation be of longer duration, or the amount of plastic exudation more considerable, or if the adhesive masses of fibrine are secreted on corresponding parts of each of the pleural layers, these may become adherent. Now these fibrinous exudations, whether they lead to adhesions or not, frequently become converted into fully organized and vascular connective tissue; indeed, these vascular masses of connective tissue, which have been developed at the expense of the fibrinous exudations, not infrequently become the foci of fresh inflammations, and of fresh inflammatory products. If the fibrinous secretion which glues together the two layers of the pleura becomes converted into organized connective tissue, it then becomes a case of *adhe-*

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[1] *Rokitansky*, Handbuch der Pathologischen Anatomie. Wien, 1844, II., p. 19.

sive pleuritis which, as we have already said, generally runs its course clinically unnoticed, and it is only by dissection we discover that such adhesion of the pleural layers is a tolerably common sequence.

This is not the place to enter into a more detailed consideration of the pathological and histological processes connected with the conversion of these fibrinous exudations of which we are speaking into organized connective tissue.

The lymph-corpuscles secreted at the same time as the fibrine, and always found in such exudations whenever we examine them (and I have done so frequently of late years), must naturally be regarded as the starting-points of this process of organization. That it cannot originate in the epithelial cells which are present, as was thought before the publication of Cohnheim's researches on inflammation, seems to me indubitable, when we reflect that these epithelial cells, whenever they are found free in the pleural cavity, or mixed up directly with the fibrinous exudation, show, almost without exception, signs of more or less advanced degeneration.

The following, according to Rindfleisch,[1] is the process of the organization of the fibrine into connective tissue. The cells which were originally round become spindle-shaped, their pointed processes meet and unite with one another; thus a great outward resemblance is presented to the well-known connective-tissue structures, and especially to the inflammatory spindle-celled tissue; scarcely has this change appeared when the formation of vessels also begins, chiefly, however, on the surface, so that the parent-vessels passing to and from the serous membrane extend to the new vascular network in only a few spots.

Fluffy, granular, and papillose formations often spring from this new connective tissue, or it forms circumscribed layers of various thickness—so-called tendinous bands. These may be formed as early as the second and third week after the commencement of the pleuritis. Or this secondary exudation may result in the formation of those thick, dense fibrous membranes composed of closely compressed connective-tissue—the so-called pleuritic false membranes—which sometimes reach three centimetres in thickness. When such membranes are formed on both pleural surfaces, they may grow together at their edges, and so form capsules with variable contents. The thicker, firmer, and more fibrous the false membrane, the less vascular it will be, and the less prone, therefore, to absorption, to hemorrhage, and to fresh inflammation. The structure of the serous membrane becomes lost in that of the false membrane. If large masses of fibrine and great quantities of fluid are effused simultaneously, the fibrine may undergo the changes here described; in other rarer cases it may ichorize (verjauchen). So, for example, in purulent exudations, in which incision has been made into the pleural cavity, stagnating masses of fibrine frequently form the starting-points of an ichorization (Verjauchung) of the whole pleural cavity.

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[1] *Rindfleisch*, Lehrbuch der pathologischen Gewebslehre. Leipzig, 1873, p. 230.

Besides the plastic exudations the fluid effusions in pleuritis are true disease-products. Transitory formed elements often appear simultaneously with the secretions of fibrinous material, and these lead to manifold changes in the physical or histological or chemical constitution of the exudation, which may therefore, during the course of an acute pleuritis, exhibit very different characters, as every physician knows who has performed paracentesis in a great number of cases and in different stages of this disease. Numerous exact chemical analyses of pleuritic exudations have been made. Those of Frerichs [1] and Hoppe-Seyler [2] have shown that its composition is closely analogous to that of blood-serum. More frequently, though not regularly, Naunyn [3] has found urea, uric acid, and cholesterine in them. Frerichs and Naunyn have sometimes discovered leucine, tyrosine, and xanthine in purulent effusions, but not unless these have been in communication with the external air. Gorup-Besanez [4] discovered parafibrine in the fluid let out by puncturing a simple hydrothorax. Ewald [5] has especially examined the gases contained in pleural effusions, and found that they are nearly analogous to those contained in healthy lymph. He has, however, observed that in purulent exudations the more they approach the character of pure pus the less carbonic acid they contain, as the carbonic acid is almost exclusively contained in the pus-serum.

Hitherto we have not been able to turn these chemical analyses to any practical account. We are only justified in concluding, as Méhu and Laboulbène have rightly maintained, that the ultimate recovery of the patient will proceed more slowly or more rapidly according as the exudations are more or less fibrinous.

The best clinical division of the various forms of pleuritic

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[1] Die Bright'sche Nierenkrankheit. Braunschweig, 1851, p. 80 et seq.

[2] Ueber seröse Transsudate. Virchow's Arch., IX., p. 252 et seq.

[3] Ueber die Chemie der Transsudate und des Eiters, Reichert's und du Bois' Arch. p. 166, etc.

[4] Lehrbuch der physiologischen Chemie. Braunschweig, 1875, 3, Aufl. III., p. 413.

[5] Untersuchungen zur Gasometrie der Transsudate des Menschen, Reichert's und du Bois' Arch., 1873, p. 663, etc.

effusion is into : 1st, The *fibrino-serous ;* 2d, The *purulent ;* and
3d, The *hemorrhagic.*

The fibrino-serous exudations are by far the most frequent,
and are the ordinary result of primary pleuritis brought on by
injurious atmospheric influences.

The fibrinous part of these effusions coagulates soon after
they are exuded, and appears partly in the form of flakes of
different sizes swimming about in the fluid ; but by far the
greater portion of the coagulated fibrine deposits itself on the
inflamed pleural folds, or on earlier formed bands, layers, or
strings, etc., of pseudo-membranous connective tissue which lie
between the two layers of the pleura. These may become satu-
rated by the serous portion of the exudation and assume, in
consequence, a gelatinous appearance.

The fibrinous coagulum is deposited in one or more layers of
unequal thickness on both pleural folds, over the inflamed area.
Its color varies from white or grayish-white to yellow, or red-
dish, or even brownish-red.   Sometimes it is soft, and easily torn
asunder ; sometimes it is harder, tough, and very elastic, and
not easily lacerated.   It thus appears that the coagulating pro-
perty of fibrine varies considerably.

The formed elements secreted at the same time are found, for
the most part, entangled in these fibrinous layers, and to a much
less extent suspended in the fluid effusion.   They are chiefly
small lymph corpuscles containing solitary nuclei, together with
a few epithelial cells, almost always in process of destruction,
and isolated red blood-corpuscles.

In these cases the pleura itself undergoes important changes ;
for not only its epithelial layer, but also its basement tissue
shares in the inflammatory process.   On section we observe
numerous young cells scattered through the connective-tissue
stratum, and these, towards the upper surface, are aggregated
into masses, and, being united together by a transparent homo-
geneous matrix, form thereon a distinct layer.   This layer
shows itself capable of organization, and is rapidly converted
into a granulating membrane composed of young connective
tissue and capillary vessels.   Over this a second non-organizable
layer of fibrine is deposited, which in many parts of the pleura

may attain even a finger's-breadth in thickness. This is at first separable from the subjacent layer, but later they both become closely united, owing to the extension and growth of the young connective-tissue membrane into the fibrinous layer. Sometimes the fibrinous exudation remains in the form of a dry, caseous mass, and undergoes no further change; generally it is absorbed after undergoing fatty metamorphosis, whilst the young connective tissue and the newly formed vessels of the opposite layers of the pleura become fused together and then lead to a supplementary organic union between the pulmonary and parietal folds.

The relative proportion between the fibrine and the albuminous serum is very variable. The latter generally amounts to one or two pints, but it may in some cases be present in much greater abundance. It has an alkaline reaction, a yellowish-green color, and a specific gravity varying from 1.005 to 1.030. The upper strata are generally quite clear, but if the fluid is shaken up the diffusion of the sedimentary particles through it gives it a whey-like aspect. The sediment consists chiefly of flakes of fibrine, and to a less extent of fat, of *débris*, and of cellular elements, especially lymph corpuscles. Sometimes the serous fluid is rendered so turbid by the presence of lymph corpuscles that we are in doubt whether to call the exudation fibrino-serous or purulent. In such transitional instances it is evidently difficult to distinguish anatomically to what class the case is to be referred. This can only be decided by its clinical course.

In *purulent pleuritis* (pyothorax, empyema) the fluid portion of the exudation is so rich in pus corpuscles that it has a more or less thick, turbid, and grayish-yellow appearance. The effusion is also generally somewhat tenacious, frequently like thin honey, and it has a more or less acid reaction. The view, at one time universally accepted, that in a number of cases pleuritis is from the first attended by a purely purulent secretion, and that in other cases a fibrino-serous effusion gradually becomes purulent, can no longer be received as true, since we have now been able to ascertain the nature of the secretion by repeated cases of paracentesis during the first week. We must now, therefore, regard it as an established fact, that primary purulent pleuritis is of extremely rare occurrence. In almost every case the effusion is at first fibrino-serous, and it is during the subsequent course that it becomes, sooner or later, purulent,

and this may occur as early as the first week. I have had abundant opportunities of verifying this statement, in recent cases, in my service at the Berlin Charité.

But it is not easy to answer the question how do these purulent exudations originate, and it is more difficult still to explain how it is that such enormous quantities of pus are again and again effused. The results which have been obtained by Cohnheim, in his tentative investigations into the inflammatory process, do not yet suffice to explain these facts. While there seems to me to be no reason to doubt that the few pus corpuscles which are present, as we have already seen, in every fibrino-serous pleural exudation may have, during the inflammatory process, wandered out of their vessels and made their way into the pleural sac ; yet this cannot be maintained of the countless number of pus corpuscles, which in the more extensive purulent effusions accumulate in the pleural sac in a very short space of time, for they far exceed in amount the whole number of white corpuscles present in the blood under normal conditions. How the pus corpuscles originate in these cases can only be determined by more exact experimental researches. Undoubtedly we cannot deny that an over-abundant development of lymph corpuscles in the spleen, in the lymphatic glands, and elsewhere, may occur in these cases, and so account for the rapid production of the purulent exudations, although many doubts might be raised *à priori* against this view. The most probable theory, however, appears to me to be that a rapid process of cell-division (from causes hitherto undiscovered) takes place among the colorless cells which have wandered out of their vessels, and which are present in the fibrino-serous effusion, and that in this way an exudation which was, in the first place, fibrino-serous, may become purulent. This may occur early or late in the course of the case, rapidly or slowly, and accordingly the pleuritis will early or late assume a purulent form, as the change in the nature of the exudation is sudden or gradual. By such a process of cell-division we can best explain the rapid new formation of extensive purulent effusions.

When we consider that in almost every case of acute pleuritis, even in the earliest days, numerous hemorrhagic spots are to

be found both in the pleura and in the subpleural connective tissue, it seems remarkable that the exudation should not, in all these cases, have a hemorrhagic character; but this is not the case. On the contrary, when we meet with a hemorrhagic exudation,—*i.e.*, with an alkaline fluid effusion, varying in color from cherry-red to brown, and in which the microscope reveals the presence of numerous red blood-corpuscles,[1] some intact, some more or less changed—we know that it is a case either of a pleuritis which has arisen as a complication of an existing hemorrhagic diathesis, and especially in purpura hæmorrhagica and in scorbutus, or of a more or less acute tubercular inflammation of the pleura, or finally, one of those instances where, after an attack of pleuritis, a part of the already organized exudative deposit becomes the seat of fresh inflammation. Virchow[2] has made us familiar with this last form of inflammation in the so-called *pachymeningitis hæmorrhagica*, and *hæmatoma peri-* or *retro-uterinum*. We see the same conditions in hemorrhagic pleuritis, and sometimes, also, as is shown in a recent communication of Friedreich,[3] in cases of peritonitis unconnected with the uterus.

The most essential part of the process is a relapsing inflammation of the affected serous membrane, attacking these organized products of inflammation, viz., the false membranes in which the development of blood-vessels is rapidly advancing, and leading to an abundant extravasation of red blood-corpuscles, not only between the pleura and the false membranes, but between the different layers of the false membranes themselves, and finally, into the pleural sac, in which there has already accumulated a greater or less amount of serous fluid. It is doubtful whether the hemorrhage should be regarded as caused by the rupture of small vessels in the false membranes, or simply by transudation; but when we reflect carefully on the slow development of deep blood-colored effusions, and on the vast abundance of vessels in the newly organized connective

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[1] Isolated red blood-corpuscles are frequently found also in fibrino-serous and in purulent exudations.

[2] *Virchow*, Geschwülste, I., p. 140 et esq.

[3] Virchow's Archiv, LVIII., p. 35 et seq.

tissue in the pleural cavity, in such cases, I think we are jus-
tified in accepting Cohnheim's conclusion that the hemorrhage
is here, in fact, the result of transudation.

These cases of relapsing hemorrhagic pleuritis are distin-
guished essentially from hemorrhagic inflammations of other
organs by the fact that they generally stand in more or less
close connection with the eruption of tubercles.   They are thus
associated closely with simply tubercular inflammations of the
pleura, yielding blood-colored effusions ; for we rarely see these
recurring inflammations in the pleura without the development,
early or later, of miliary tubercle in the deposited false mem-
branes.   In such cases, frequently, even during life, the tuber-
cular nature of the pleuritis is evident, or at least highly proba-
ble.   For in some instances it occurs in individuals in whom the
pleuritis has followed on disease of the parenchyma of the
lung, and in whom, on post-mortem examination, either simple
caseous deposits with their products have been formed in the
lungs, or we find a true tubercular eruption in the parts adjacent
to the tubercularized pleura ; in other instances, it occurs in old
or elderly people, in whom, in the course of pleuritis, a tuber-
cular state of the pleura has been developed, and has led, during
the relapsing inflammation, to hemorrhagic exudation, and in
whom, on post-mortem examination, no recent or pre-existing
caseous or tubercular deposits can be discovered.

A simple tubercular pleuritis, unattended by the production
of these vascular false membranes, but seldom (and then mostly
in somewhat acute cases) produces a hemorrhagic exudation ; in
many other cases the effusion is not sanguineous.   Why there
should be hemorrhage in one case and not in another, we cannot
at present satisfactorily account for.

In the third category of hemorrhagic exudations, viz., those
occurring in persons who present the hemorrhagic diathesis,
the diathesis sufficiently explains their occurrence.

All pleuritic effusions lead naturally to a number of local
and general pathological conditions, partly owing to the quantity
and quality of the exudations themselves, and partly in conse-
quence of the changes which these exudations gradually undergo.

On the amount of the exudation will chiefly depend the

amount of compression of the subjacent lung, as well as the extent of the displacement and compression of adjacent organs, as, for example, the mediastinum; the opposite lung; the great venous, arterial, and nervous trunks contained within the thorax; the diaphragm and organs underlying it; and also the external bulging of the chest-wall on the affected side. How important these variations may be we can readily understand, when we reflect that the quantity of fluid effused may be only a few ounces, or it may be as much as from ten to twenty pints. The largest effusions are found in connection with hemorrhagic inflammations of the pleura.

So long as the lung, which in the normal state is retained within the thorax, in a condition of distention, can, by virtue of its elasticity, retract before the exudation without reaching its (elastic) equilibrium, it remains permeable to air, and cannot be said to suffer any pressure from the effusion.

With increase of the effusion and exhaustion of the contractile power of the lung, the pressure of the fluid begins to be experienced. So long as the lung remains permeable to air it floats on the surface of the effusion, and it is only when all the air is pressed out of it that it sinks in the fluid. This kind of compression begins from below and extends gradually upwards, so that the lung is forced back towards its root and against the spine, and in this situation, by the continued increase of the effusion, it is compressed upwards and inwards against the vertebral column and the mediastinum, until, at last, it assumes the appearance of a flat, tough, gray, or grayish-black, or brownish, or pale-reddish, bloodless, and airless cake. This is what usually happens when the pleuritic effusion steadily increases, unless resisting adhesions between the pleural layers have taken place to a greater or less extent before the development of the pleuritis, or before the increase of the exudation. In these latter cases the displacement of the lung frequently takes another form and direction. Mohr[1] has compiled the following statistics, based upon numerous observations, as to the mode of displacement. In twenty-three cases the lung was free from

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[1] Beiträge zu einer künftigen Monographie des Empyems. Kissingen, 1839.

adhesions, and compressed in the usual manner against the vertebral column and the mediastinum ; thirteen times the displacement was from below upwards, four times from within outwards, four times from behind forwards, four times from before backwards, and once from above downwards.

Adhesions most commonly occur at the apices of the lungs, and the upward extension of the effusion is thus limited. For this reason, when in the course of caseous pneumonias extensive pleuritic effusions take place, it very rarely happens that they are followed by complete compression of the subjacent lung, since in these instances of caseous pneumonia adhesion between the pleural surfaces at the apices of the lungs commonly occurs. In rare cases we find the adhesions at the lower part of the pleural cavity, and the effusions above them.

These conditions are often very difficult to make out, and we may, for example, omit to perform paracentesis when it is urgently called for, because we are uncertain as to the amount of the effusion. About two years ago, in my department in the Charité, I had a case of left-sided pleurisy, with effusion, in a man sixty-two years of age, where there was extreme displacement of adjacent organs, while, at the same time, in the left mammary region, under the fifth rib, there was a clear note on percussion, yet the indication for paracentesis was urgent and unmistakable. A puncture was made in the second interspace outside the mammary line, and more than fifty-three ounces of hemorrhagic exudation were withdrawn. The diagnosis arrived at during the life of the patient, viz., that adhesions had formed between the pleural layers at its anterior and inferior part, and that the lung was compressed from above downwards by effusion, was confirmed on dissection.

Sometimes the exudation is multilocular, that is to say, it is contained in large, intercommunicating spaces, formed by bands and networks of connective tissue. In other cases the effusion is so considerable that it overcomes the resistance offered to its extension by the partial band-like adhesions of the pleural surfaces, and these are torn through. If, however, they are capable of resistance, then the more they hinder the extension of the exudation in their direction, the sooner will pressure be experienced by the other parts of less resistance. An analogous state of things arises when the lung itself is rendered capable of resistance by infiltrations and the like, and can only be compressed in parts.

Wintrich [1] rightly calls attention to the fact that the rapidity with which the exudation is poured out must exercise a great influence on the subsequent anatomical changes. If the effusion is poured out very rapidly, just as rapidly will the lung, by it, be emptied not only of air but also of blood, even before the illness has had time to bring about any notable diminution of the amount of blood in the body. Pulmonary insufficiency, with all its consequences, will immediately appear in the opposite lung, to which, naturally, much more blood will be conveyed. I am unable, on the other hand, to adopt Wintrich's opinion that the lung thus rapidly compressed cannot, henceforth, either in its own tissue or its pleural covering, be the seat of hyperæmia, hemorrhage, or transudations, and I have made many observations bearing on this point. I have seen quite acute extensive pleuritic effusions—and in two cases so urgent was the indication for paracentesis that I was forced to puncture the chest even on the eighth day of the illness—exhibit a strikingly hemorrhagic character.

How the increasing displacement of neighboring organs follows steadily the increase in the effusion, we shall discuss more fully when dealing with the symptomatology. The heart is generally simply displaced to the right or the left, unless some special abnormality in the displacement is induced by coexisting pathological changes acting in another direction. The compression of the great venous and arterial trunks within the thorax, as well as the thoracic duct, and the pressure on the mediastinum, the intercostal spaces, the diaphragm, and the subjacent organs, are self-evident. The capability of distention of the intercostal spaces, however, varies greatly and depends especially on the rigidity or elasticity of the ribs (an old or young thorax), as well as on the rigidity of the intercostal muscles. As regards the diaphragm, a considerable difference is observable according as the effusion is on the right or the left side, a larger surface being exposed to pressure on the right side than on the left. Hence it arises that in effusions in the right side the signs of downward pressure appear earlier than in those on the left side.

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[1] Loc. cit., p. 237.

In women the diaphragm yields earlier than in men. The presence of large abdominal tumors may exercise an important influence in resisting downward displacement, as for instance an advanced state of utero-gestation, extreme meteorismus, etc., or analogous hindrances may proceed from adhesions between the liver or spleen, and the diaphragm or adjacent portions of the peritoneum. The statement, that in excessive pleuritic effusions on the right side the liver is displaced to such an extent that its suspensory ligament forms, as it were, a fulcrum (Hypomochlion) on the left side of which the left lobe of the liver rotates upward (displaces the heart) to the same extent as the right lobe of the liver is pressed downwards, is untrue. Traube first called attention to the fact, that in large pleuritic effusions on one side, the diaphragm on the other side descends lower than under normal conditions. For the sound lung is compressed laterally by the displaced mediastinum, and its tension is consequently diminished, so that the diaphragm can assume a flatter form, which under normal conditions it is prevented from doing by the tension which the lung exercises on its upper surface. It follows naturally from the flattening of the diaphragm that the lung, tissue must extend lower down on that side than is natural. We shall again treat of these conditions more fully under symptomatology. Moreover, the depression of the diaphragm is, in some instances, so considerable that it may, as well as the fluid compressing it, project beyond one or other of the costal arches.

It has been already mentioned that not only are a number of anatomical changes induced by the *quantity* of the effusion, as we have just shown, but also that other decided anatomical lesions depend on the *quality* of the effusion. This is especially the case with regard to the purulent and ichorous exudations. These possess, if long persistent, corrosive properties, and lead subsequently to a greater or less extent of necrosis of the pulmonary or costal pleura. The pulmonary pleura may be destroyed, to a greater or less extent, from a portion no bigger than a pin's head to that of the size of a sixpence. In this way a passage may be opened for the pus into one of the smaller or larger bronchial tubes, and a larger or smaller quantity may thus be discharged. According to the generally received opinion this must

lead to a pyopneumothorax, unless the perforation is very
deeply situated, or the pleural layers have contracted abnormal
adhesions, or unless the perforation is in an altogether peculiar
position.

There are cases in which the perforation has a completely valvular form, admit-
ting the passage of pus from the pleural cavity into the bronchia, but becoming
hermetically closed when air or pus tries to make its way in the opposite direction,
into the pleural sac.

Traube has recently taught us[1] that when necrosis of the
pleura pulmonalis takes place in the course of a purulent effu-
sion, it is only in the rarest cases that it leads to pyopneumo-
thorax, and more frequently it tends to a direct cure; for by
the destruction of the pleura pulmonalis the fine-meshed alve-
olar tissue of the lung is laid bare, and through this the puru-
lent fluid becomes pressed, as through a spring, into the bron-
chia, without, at the same time, any escape of air taking place
into the pleural cavity. The pus is driven into the bronchia by
the strong pressure which the fits of coughing, by narrowing the
thorax, exert upon the pus contained in the pleural sac, and it
is thus enabled to overcome the great resistance which the
minute cavities of the alveoli and infundibula oppose to its
passage. On the other hand, if the affected side of the thorax is
scarcely at all flexible, or dilatable, it lacks the necessary force
required to draw the air contained in the air-passages into the
pleura. These conditions co-existing, the pus becomes dis-
charged through the bronchia without the establishment of
pneumothorax. Traube mentions the interesting fact, that of all
the physicians who, for centuries, had occasion to observe cases
of empyema, Hippocrates was the only one to notice this pro-
cess. At least Hippocrates has certainly noted the clinical fact,
although he may not have completely comprehended the con-
nection of the facts observed.

The knowledge, anatomical as well as clinical, of this last
described form of necrosis of the pleura pulmonalis, and the con-
sequent cure thereby of purulent pleural effusions, is so little dif-
fused, that an erroneous supposition has prevailed that perfora-
ation of the pleura costalis with its consequences is a much more

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[1] Verhandl. d. Berl. med. Gesellsch., Bd. IV., p. 54 et seq.

frequent result of purulent exudation than it really is.   Even if
we disregard those frequent instances, already mentioned, of
perforation of the pleura pulmonalis without the development of
pneumothorax, yet pyopneumothorax is a much more frequent
result of purulent effusion into the pleura than are destruction of
the pleura costalis, and its final result, an *empyema necessi-*
tatis; at any rate such is the conclusion from my own observa-
tions during many years at the Berlin Charité.   In this case the
pus penetrates the muscles of the thorax, and gradually appears
under the skin as a tumor of variable size.   As the external
intercostal muscles do not reach beyond the cartilages of the
ribs, the wall of the thorax becomes thinner as we get near to
the sternum, and here the empyema necessitatis usually points
by preference.   The fistulous channel runs from within outward,
in an oblique, angular manner, the internal perforation being
variable in size, and with edges having a corroded, torn, and in-
dented appearance.   Not infrequently such perforations lead to
caries of the ribs.

In rare cases, however, the external abscess is the primary
disease, and the pus makes its way hence into the pleura, and
so sets up an empyema.   Though much less frequently than
through necrosed portions of the pleura pulmonalis, or costalis,
the pus sometimes makes a passage through the diaphragm.

This either happens in a *diffuse* and *acute* manner through
the lymphatics of the diaphragm, and sets up an acute and
invariably rapidly fatal peritonitis, altogether analogous to the
purulent, usually double-sided pleurisies, which also result from
the extension of the purulent inflammation through the lym-
phatics of the diaphragm in purulent puerperal peritonitis, and
which are pretty generally fatal, or, in other cases, the pus
perforates the diaphragm in a definite direction, and makes its
appearance, for instance, as a psoas abscess under Poupart's
ligament, or in the region of the navel, or in the popliteal space,
or after perforating the intestine, it is discharged through the
rectum.   If the pus once reaches the peritoneal sac, or gets
behind it, one can scarcely exhaust all the possible channels it
may subsequently take.   Sometimes the pus finds its way into
the mediastinum, and hence into a main bronchus, or into the

trachea, or even into the other pleural cavity. Its passage into the pericardium, or into one of the great vascular trunks, must be regarded as a great rarity. It is less rare for an abscess to bore its way from the abdomen, or the œsophagus, through the diaphragm or the costal pleura, and thus give rise to secondary purulent pleuritic exudations. Perforations from the abdomen arise in various ways; they may be caused by abscesses of the liver or spleen, by abscesses situated between the diaphragm and these organs, by rupture of hydatids of the liver, of renal abscesses, of purulent channels proceeding from the cellular tissue around the cæcum in connection with perforation of the vermiform appendix, and through which, according to Krause, fecal fistula may reach the thorax, and partial empyema be produced. Luschka once saw round worms enter in the pleural sac, after perforation of the diaphragm had established a communication between the pleura and the intestinal canal. Foreign bodies also, which have found their way into the bronchial tubes—as, for example, artificial teeth, according to Carpenter's observations—may by degrees reach and perforate the pulmonary pleura. Cancer of the œsophagus not infrequently leads to ulceration into one of the pleural cavities, and consequently to the escape of food therein.

In fibrino-serous effusions recovery commences, in most cases, by the gradual concentration of the exudation. In consequence of this, absorption proceeds much more rapidly at the beginning than it does later on. Finally the fluid portion of the exudation entirely disappears, and the pleural surfaces, roughened by deposits, come again into contact, and often become fused together in the manner already described. We often find embedded between the pleural folds considerable masses of yellow, caseous material, which represent unabsorbed residua of the fibrinous deposits, and of the cellular elements of the exudation.

If the process of absorption sets in sufficiently early, the compressed lung again becomes permeable to air, and re-expands; the intercostal spaces return to their normal state, and the mediastinum and the diaphragm, together with the displaced heart and liver, return to their natural situations.

Finally, it remains for us to form an accurate idea of the

anatomical changes which arise, in those quite chronic cases, in which the exudative deposits become organized into masses of connective tissue.

If in the course of the pleuritis repeated exudations take place, which subsequently undergo organization, there are at last formed, very frequently, thick masses of connective tissue which appear as *fibro-cartilaginous membranes*, of greater or less extent, adhering to the pleura pulmonalis, or often in smaller insulated patches, like the tendinous spots which are found on the surface of the heart, and still more frequently on the pleura costalis, as layers of sometimes an inch in thickness. The serous membrane itself and the subserous tissue are often merged in these new formations and can no longer be distinguished; often, however, they are only moderately thickened, and in some cases they are quite normal. If the pleura pulmonalis is itself affected, it always appears thicker on section and shrunk on the surface. This leads to retraction of the subjacent lung tissue, the hilus of the lung forming the centre of the retraction, while the margins of the lung become rounded by this *pleuritis deformans*. The space left free in the pleural sac by this retraction of the lung becomes filled with fluid, which has less chance of being absorbed the thicker the pleura becomes, since as the pleura thickens it loses more and more its absorbent power. Thus the capability of expansion in the adjacent lung is forever lost. But if the pleura becomes covered with thick false membranes while there is considerable effusion in the pleural cavity, and before its absorption has been possible, this circumstance hinders its further absorption, and the remainder of the exudation may continue, in varying extent, form, and quality, confined and encapsuled by the false membranes for months and years. The thicker and more fibrous the false membranes the less vascular are they. Calcareous deposits occasionally form in them, especially on the pleura costalis, and in the form of plates, bands, streaks, etc., give rise to the so-called ossification of the pleura.

If, however, in the course of a pleurisy, the organized false membrane, as is seen in chronic abscesses, assumes a *pyogenic* character, from which pus is continuously secreted, and, when a

perforation has at the same time taken place either through the costal or pulmonary pleura, is as continuously discharged, we may observe the persistence of inflammatory irritation for a long time—often for many years—and this may lead to the effusion of coagulable fibrinous material (as well as pus) which, steadily undergoing organization, gradually diminishes the space in which the pus can accumulate, and in a few cases may cause it to disappear altogether. The membranes on the costal and pulmonary pleura then come into contact, grow together, and become a closely cohering mass.

Where these thick membranous formations exist, the re-expansion of the compressed lung is naturally impossible. As the fluid effused in the earlier stage of the disease becomes absorbed, or as the lung diminishes more and more in size, there is a tendency, as in *pleuritis deformans*, to the formation of a vacant space, unless new watery effusions are poured out between the layers of exudation. The adjacent movable organs, as well as the thoracic walls themselves, must contribute to the filling up of this vacuum. The affected side of the chest sinks in more or less; sometimes to such an extent that instead of being convex it becomes concave; the intercostal spaces become more and more narrowed by the retraction of the pleura, till, in extreme cases, they finally touch; the shoulder becomes depressed, and the spine bent, with its concavity towards the affected side; the diaphragm, and with it the liver, rises abnormally high; the heart, if the disease is on the right side, may be drawn quite over to that side, beyond the right margin of the sternum; in left-sided effusions it is displaced upwards and to the left. There need not be in these considerable displacements of the heart any adhesion between the pericardium and the pleural membranes. I have seen many cases in which a chronic pleuritis had led to a great shrinking of the right lung, and the heart lay quite outside the right margin of the sternum, where the pericardium showed no sign of abnormal adhesion. Here the heart had simply changed its place to fill up the vacancy which had arisen, aided, perhaps, in its movement to the right by the simultaneous secondary increase in volume of the left lung.

Symptomatology.

General Aspects of the Disease.

Fever.

Pleuritis very rarely commences with a single, well-marked initial rigor; and since we have learnt, by recent experience, that acute pleuritis is often accompanied by a circumscribed attack of pneumonia, running a somewhat latent course, it is still doubtful whether these initial rigors are not to be ascribed to the co-existing pneumonia.

Far more frequently we observe, in the beginning of pleuritis, slight shivering fits, of daily recurrence, often for eight days or longer. Should these occur while the patient is well enough to be about, they are of no great importance. But if after the patient is confined to his bed he daily suffers from violent rigors, not merely slight shivering fits,—whether they come on at fixed hours of the day or not—the suspicion becomes very strong that there is either co-existing caseous pneumonia or that the pleuritis is tubercular or purulent. The body temperature will be regulated by the acuteness of the attack and by its results.

It is very slightly or not at all raised in those cases in which pleuritis attacks persons who are already approaching dissolution in consequence of some chronic disease, such as cancer, chronic renal disease, and the like, and to whom the supervention of pleurisy proves rapidly fatal.

In these instances the temperature is already reduced by inanition, and the advent of the inflammation rarely raises it above 100° F. In healthy individuals, on the contrary, acute pleuritis usually sets in with a higher temperature, 102° to 104° F. The temperature continues to rise during the first three or four days, and then remains for eight or ten days at a tolerably constant elevation, with scarcely perceptible morning remissions. A lowering of the temperature generally becomes manifest about the beginning of the third week of the illness, the morning temperature slowly sinking to the normal, while the evening temperature may still rise to 102° F., and we thus may sometimes be led to imagine that we have to do with a hectic fever, until the

gradual fall of the evening temperature makes the case plain. The more, however, a simple case of acute pleurisy tends to assume a chronic form, the longer does the evening elevation of temperature continue.

If the temperature of an originally acute pleuritis remains for a long time—four weeks or more—at the same height and above 104° F., we may conclude that the case is tubercular or purulent, more probably the former ; since, generally, in the case of purulent effusions, towards the end of the third week, the fever assumes a remarkably intermittent type—the temperature in the morning being normal or subnormal, while the evening temperature rises from 102° to 104° or higher. This gives place to a completely normal temperature when the pus is let out. In rare cases, however, a tubercular pleuritis will assume a hectic type.

The highest temperatures—even over 106° F.—are observed in pleuritis acutissima.

In chronic pleuritis, when there is no purulent or tuberculous inflammation, the temperature seldom rises above 102° F., but will remain for weeks ranging between 100° and 103°. So long as the temperature keeps high we may safely conclude that fresh extensions of inflammation are taking place in the pleura.

It has been maintained by many and disputed by many that the temperature of the skin is higher on the affected than on the sound side. In order to be clear on this point I have made numerous comparative estimates, in the most careful manner, of the temperature of the skin ; only in rare cases did I detect a constant difference of temperature prevailing through many days, and then not more than 1.1° F.

If the temperature of the affected side remained persistently high, it was almost certain to be a case of purulent effusion ; in only two cases was the effusion sero-fibrinous.

Peter also, in a case of purulent effusion into the pleura, has observed a higher temperature on the diseased than on the healthy side, without basing upon this observation any further conclusions.

The Pulse.

In recent cases the frequency of the pulse bears a pretty constant relation to the height of the fever ; in purulent *pleuritis*

acutissima it rises to 120 or 140 beats in the minute ; in ordinary tuberculosis and purulent exudations it varies between 100 and 120, and in sero-fibrinous effusions it does not as a rule rise above 100. The frequency of the pulse is naturally highest in children, and higher in women than in men.

In treating a case of pleuritis we should never omit to make detailed observations of the pulse. For, even when the fever is materially subsiding, any increase in the amount of the exudation is accompanied by increased frequency of pulse. With the increase of the effusion, also, the fulness and tension of the artery are diminished, for, as the lung becomes compressed by fluid, a sufficient quantity of blood cannot pass out of the right ventricle into the lungs, and through them into the left side of the heart and the arterial system. As the arterial tubes become narrower and narrower, we may infer directly that less and less blood is carried into the aorta and the arterial system, and the danger to the patient's life is thereby steadily becoming greater. If the exudation rapidly diminishes, or if it is in any way discharged outwardly, the arteries will be felt, under the finger of the observer, to become fuller, while their pulsations diminish in frequency.

Respiration.

In every case of pleuritis the respiration is abnormally frequent, purely costal and superficial ; in the first place, because every fever-patient breathes more frequently and superficially than natural, and in high fever there is generally dyspnœa ; in the second place, the stitch in the side, peculiar to all pleuritic inflammations—and to which we shall refer more fully by and by—and indeed all pain, leads to frequency and often difficulty of breathing. Moreover, in superficial and costal respiration the diaphragm is maintained as fixed as possible, and any strong movement of the inflamed pleural surfaces over one another, which would materially increase the patient's pain, is thus prevented. Now, to produce the same effect as ordinary breathing, these superficial costal respirations must be more frequent. At the same time, in pleuritis, the affected side, during respiratory expansion, recedes more or less considerably when compared

with the sound side ; that is to say, if the lung is still capable of partial or complete expansion. If the lung is quite compressed, the affected side remains motionless during inspiration. As the exudation increases dyspnœa becomes more marked. In males the sterno-cleido-mastoid and the scaleni first, and then, in both males and females, the other accessory muscles of inspiration, come into action. This is sometimes observed first in the levatores alæ nasi. But the intensity of the dyspnœa depends not only on the amount of the effusion, or on the extent of any lung affections that may exist as a complication of the pleurisy, but it is also proportionate to the richness of the blood, and therefore to the state of the patient's general nutrition. For dyspnœa arises when, in a given time, an unusually large quantity of carbonic acid acts as an irritant on the respiratory nerve-centres.[1] When an acute pleuritis in a strong, plethoric person leads rapidly to a considerable effusion of fluid, the lung on the affected side becomes greatly compressed by this fluid, and the entrance of the normal amount of oxygen into the lung is rendered impossible ; the blood, therefore, becomes richer in carbonic acid. In a given time, and in a definite quantity of blood, an abnormally large amount of carbonic acid reaches the respiratory nerve-centres, and in consequence excites dyspnœa and not ordinary respiration. If a similar attack, with an equal quantity of rapidly developed effusion, occurs in a person whose constitution has been weakened by long illness, profuse suppuration, or great loss of blood, and whose blood is on that account impoverished, dyspnœa may be altogether absent. For in this case the medulla oblongata and the respiratory nerve-centres will be found in a condition of imperfect nutrition and defective excitability. Hence, although the compression of the lung on the affected side interferes with the admission of fresh oxygen into the blood in precisely the same manner as with a plethoric person, and although in proportion to the quantity of the blood, the accumulation of carbonic acid in it is equally great ; yet it must happen with the anæmic person that in a given time

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[1] *Traube*, Ueber das Wesen und die Ursache der Erstickungserscheinungen am Respirations-Apparat, Ges Beitrage, I., p. 452 et seq.

a smaller quantity of blood reaches the medulla oblongata, and therefore a less amount of carbonic acid will be conveyed, as stimulus, to the badly nourished, and in consequence less excitable, respiratory nerve-centres. This is the reason why robust persons, when they become the subject of acute pleuritic effusion in large quantity, suffer from such intense dyspnœa. Whereas the same individuals, if the pleuritic effusion accumulates slowly, and only reaches the same extent after an exhausting illness has led to impoverishment of the blood, may remain tolerably free from dyspnœa. The same remark applies to cachectic persons, in whom an equally great amount of effusion has arisen in an acute manner.[1]

Position of the Patient.

When there is intense dyspnœa there is always orthopnœa, so long as the patient's sensorium is not affected, nor his strength entirely exhausted, and for the following reasons. In the first place, when such a patient sits up in bed, he can use his accessory muscles of inspiration with much greater effect than when he is recumbent; in the second place, in the upright position the chief pressure of the effusion will fall on the diaphragm, which yields readily, and thus the pressure on the affected lung, as well as that on the sound lung, through displacement of the mediastinum, is diminished.

The position of the patient in pleuritis is often one of the most characteristic symptoms.

At the outset of the illness, when there is scarcely any effusion, the patient usually lies on the sound side. Traube accounts for this in the following manner.[2] The blood-stream in the veins of the side on which the patient lies has to flow against the action of gravity, and therefore has to overcome a greater resistance. The pressure to which the sensory efferent nerve-fibres of the diseased membrane are exposed from the increased accumulation of blood in the already unnaturally distended vessels, would thus be necessarily increased. And with

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[1] *Traube*, Ges. Beitr., II., p. 1036 et seq.
[2] *Traube*, Symptome der Krankheiten des Respirations-Apparats, p. 3.

the increase of this pressure, the pain and tendency to reflex movements, which may be produced by irritation of these fibres, must increase. To avoid this increase of pain, the patient naturally prefers to lie on the healthy side. If the exudation becomes greater, he still lies on the sound side at first, because the pain is, at this time, generally diminished ; but if the effusion still increases, to remain in his old position would involve not only compression of the lung on the affected side, but compression also of the sound lung, through the displacement of the mediastinum. And, finally, since such a large effusion always weighs several pounds, if the patient lies on the affected side he will avoid having to support this weight, and spare himself a premature fatigue of the respiratory muscles.

The observant physician, therefore, when he sees a patient, whom he has been treating for a recent pleuritis, and who has hitherto been lying on the sound side, suddenly place himself on the affected side, will rightly conclude that the quantity of the effusion has rapidly and greatly increased.

Pleuritic Pain.

Pain in the chest, or, as we are in the habit of calling it, pleuritic pain, or "stitch in the side," is one of the commonest symptoms, at least of acute pleurisy, although it may sometimes be entirely absent. According to Valleix, it was present in forty cases out of forty-six. In speaking of respiration and position we have already briefly alluded to the symptoms dependent upon it. It usually comes on with the first rigor, but often a few hours, and sometimes, though very rarely, a few days after it. Almost without exception the pain in the affected side is of a stabbing character, but sometimes it is described as of a tearing, cutting, dragging, screwing, or pressing kind. Usually it is limited to a small spot, sharply circumscribed, sometimes it is more diffused and spread over a larger surface.

When the pain is circumscribed its favorite seat is one of those points found most painful in intercostal neuralgia : generally under or close to the nipple, in the fifth, sixth, or seventh intercostal space, less frequently in the subclavicular region as far

as the second or third rib, or in the scapular region, or from the axilla downward to the margins of the ribs, under the sternum, and elsewhere. Those cases are very rare in which no pain is experienced in the affected side of the chest, but is referred to the hypochondriac or epigastric region, or appears in the form of lumbago. Laënnec's assertion, that while the pleuritis is on one side of the chest the pain is sometimes on the other, has been directly contradicted by Andral and Wintrich. Gerhardt has recently corroborated Laënnec's observation, and, in order to explain it, has supposed that there is an anastomosis of the sensory nerves of both halves of the chest in the anterior mediastinum, and one of his pupils, Huss,[1] has striven to prove it with more anatomical accuracy, but his results do not appear to me to be convincing. At any rate, the observations and the hypothesis of Gerhardt have given us occasion to pay closer attention to the occurrence of pleuritic pain on the other side of the chest. I have never myself observed such a case.

The intensity and duration of the pleuritic pain vary greatly in each case; sometimes it is almost insupportable; more commonly it is of moderate severity; often it is very slight or almost entirely absent, and only given rise to by deep inspirations, violent coughing, sneezing, strong percussion, and the like.

Whether the pain appears as a precursor of the rigor, or at the same time with it, or after it, we rarely observe it to be continuously present during the whole course of the disease. It is usually most intense just at the beginning, and then, in case no direct therapeutic means are used for its removal, it diminishes after four, six, or perhaps eight days, or it may disappear suddenly on the second or third day, consistently with a rapid increase of the effusion and an abatement of the general symptoms. But sometimes it appears, at first, as a dull pain, and then, after two or three days, it becomes violent, fixed, and continuous, and diminishes again by degrees, or even disappears suddenly. All these modifications in the appearance and duration of the pain are of no decided diagnostic value. So long,

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[1] Archiv f. klin. Med., IX., 242.

however, as a trace of pain remains, it must always be regarded as certain that the inflammatory process in the pleura is not yet extinct, although the pulse and the temperature may long have been normal. In like manner, if, after the cessation of a pleuritis, a severe pain appears anew in the side of the chest which has been affected, although there may be an absence of fever, this circumstance justifies the conclusion that there is a return of the inflammation. The more violent the pain, the shorter, quicker, and more superficial will be the respirations. I have seen many cases of acute pleuritis, in which, during the first day or two, the pain was so severe that the most intense dyspnœa and general distress were produced, while unmistakable signs of collapse were to be observed in the patient's countenance. This always indicated, according to my observations, a secondary pleuritis, arising in the course of a chronic caseous pneumonia. The form of the illness appeared so alarming that I was inclined to suppose each time, judging from the outward demeanor of the patient, and the statement that the pain and dyspnœa had arisen quite suddenly, that I had to do with a case of pneumothorax. A more careful examination proved that this was not the case, yet no exudation was to be detected in the pleural sac. If the latter became possible, then the pains always quickly abated. In two of the cases here alluded to, the pain extended from the affected side (it was the left side in both cases) into the epigastrium as far as and beyond the navel, and might, in the first moment, have excited a suspicion of inflammation of the peritoneum.

Children and old men, persons of unsound mind, and such like, with whom the effusion increases but slowly, must frequently have little or no sensation of pain.

So-called nervous, irritable persons do not always necessarily suffer violent pains. These are often excited, and are always increased, by coughing, sneezing, laughing, pressing, by quick and deep inspirations, by external pressure, especially between the intercostal spaces, by percussion, and generally by a sudden change of a long-maintained recumbent position. Sometimes the pain only comes on with the evening febrile exacerbation, and disappears during the remission. Tubercular and purulent

exudations are distinguished from the sero-fibrinous by the longer duration and the greater intensity of the pain, two circumstances which afford a reliable basis for the diagnosis of such cases.

The question as to what is the relation which exists between the pleuritic pain and the local disease is one which has been frequently discussed, but not yet finally decided. Cruveilhier refers it to the friction of the inflamed costal layer of the pleura against the pulmonary layer. Opposed to this view is the fact that in many cases a loud friction sound is to be heard without, at the same time, there being any complaint of severe pain; or the friction sound is heard at a spot remote from the seat of pain. Copland's hypothesis, that the pain is caused by expansion of the inflamed pleura during inspiration, is contradicted by the consideration that the pain frequently appears quite circumscribed, and is aggravated by pressure on the intercostal spaces, by lying on the affected side, and the like. It must at any rate be admitted that inflammation of the pleura itself, when there is no violent dragging on it, may give rise to more or less pain, and that this pain arising in the pleura itself may be increased by direct pressure on the wall of the thorax. It often appears to be accompanied by an inflammation of the intercostal nerves, or their neurilemma. The pain often assumes altogether the character of that of intercostal neuralgia, and then it extends only over a certain number of intercostal spaces. The pain of pleuritis is usually found to be especially severe over certain distinct points of pressure, and this is particularly observable in those cases in which there is some œdema of the affected side. Naturally we cannot state accurately how far, in individual cases, the production of the pain is dependent on the disease of the pleura, or on the secondary affection of the intercostal nerves; but, so far, I feel bound to confirm the opinion of Beau, that the coexisting affection of the nerves is of great importance, and cannot be absent when the pain is violent.

Cough and Expectoration.

Very few cases of pleuritis run their course without any cough. Frequently it does not appear till late. This is the case in those pleuritic effusions which run a latent course, unaccompanied by fever, and of which, for a long time, the chief symptoms are a sense of oppression at the chest, and shortness of breath. To these symptoms that of cough becomes superadded, especially on any sudden change of position. Generally, however, there is some cough from the first.

It is short, frequent, and suppressed, because of the increase of pain to which it gives rise. It is usually most severe during

the few first days. After the fourth or sixth day, when an abundant effusion into the pleural sac has taken place, it becomes slighter and disappears, either when the exudation has attained a considerable amount or with the decline of the illness. The cough occasionally returns for a short time during the absorption of the effusion. In this case there is no expectoration, or merely a little tracheal or bronchial mucus, which is brought up with difficulty. Often the patient will cough when certain parts of the affected side are touched or percussed.

It is difficult to explain the origin of cough in pleuritis unaccompanied by bronchial catarrh, especially if we accept the experiments of Nothnagel as conclusive, which, however, Kohts[1] calls in question to a certain extent. If irritation of the pleura directly excites fits of coughing, as was very generally believed prior to the publication of Nothnagel's experiments,[2] no further explanation naturally is needed of the cough, which usually accompanies inflammation of the pleura. But if Nothnagel is right in maintaining that irritation of the pleura does not produce cough, we can only explain its occurrence by the consideration that in pleuritis, as soon as there is any effusion, some slight pressure must be exercised on the lung tissue and the bronchia; a pressure, however, which can still always be overcome by the act of inspiration. Hence arises an unnatural strain on the lung tissue and the finer bronchia, and this excites coughing. The same cause of strain will arise in cases of considerable effusion when the patient changes his position; then the patient must inevitably cough. Cough brought on by every change of position is one of the characteristic symptoms of large effusions into the pleura, and frequently induces an experienced physician to suspect, with probability, the existence of such an effusion even before he has made a physical examination. But if the lung is completely compressed by the pleuritic effusion, then no actual strain on the alveoli or the bronchia can arise; in such cases there is no cough, but it returns when the effusion decreases in quantity, and quite violently if this occurs sud-

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[1] Virchow's Archiv, LX., p. 191.
[2] Virchow's Archiv, XLIV., p. 95.

denly, as, for instance, in puncture of the chest. We shall have occasion to speak again of the fits of coughing induced by this latter circumstance.

In the cases we have hitherto mentioned, if we disregard complications with bronchial catarrh and diseases of the lung tissue itself, the cough is dry, and attended with little mucous or muco-purulent expectoration. Frequently, however, in purulent effusions the cough quite suddenly increases, and is accompanied by an abundant muco-purulent expectoration. This is of a grayish-yellow or greenish-yellow color, muco-purulent, not ill-smelling, enormously abundant, often amounting to between thirty and forty ounces in twenty-four hours. It has no tendency to assume the form of globular masses. Pus corpuscles in greater or less number are sometimes set free from this expectoration and collect at the bottom of the spitting-glass as a pure layer of pus. Sputum of this kind justifies the certain conclusion that the purulent effusion has, in the manner described by Hippocrates, and more recently by Traube, led to necrosis of the pleura pulmonalis in one or more small circumscribed spots, and that the pus has filtered through the lung tissue, especially when we can detect that the effusion diminishes or increases with the increase or diminution of the expectoration.

If instead of these insensible, if I may so call them, perforations of the pulmonary pleura, more severe and extensive ones occur, so that the lung tissue is torn as far as one of the larger or smaller bronchial tubes, then a violent paroxysm of coughing sets in quite suddenly and expels numerous purely purulent and often fetid masses which fill up all the bronchial ramifications. Should such a perforation take place while the patient is asleep, the consequent overflowing of the bronchia may lead to the suffocation of the patient before he wakes out of his slumber. But this pathological process is not without great danger even when it happens during waking hours, for if the patient, through the long duration of the illness, has become very weak, muscularly, he may not have power to expectorate the pus as it streams abundantly into the bronchial tubes, and in that case he must suffocate. If, however, by means of violent fits of coughing the pus is forced out in sufficient quantity, a

pyopneumothorax is the result, unless there are special circumstances which prevent it.

Aspect of the Countenance, Emaciation, Loss of Strength.

When pleuritis interferes with the function of respiration to the extent of actually preventing the decarbonization of the venous blood, then the mucous membrane of the lips and such other portions of mucous membrane as are visible, as well as the skin of the cheeks and ears, and in severe cases even the hands and feet, become cyanosed. The more intense the cyanosis the greater, naturally, is the interference with the function of the lungs, and the greater is the danger to the life of the patient. It is often the cyanosis itself which first leads us to suspect the existence of pleuritic effusion, as in chronic consumption and in the course of caseous pneumonia, where cyanosis never appears except as the consequence of a special secondary affection. This point will be confirmed by the experience of every hospital physician who has had much to do with the treatment of cases of consumption. The existence of cyanosis in these cases should make us certain that some complication is present, and this is frequently a pleuritic effusion.

When the patient is very pale the cyanosis is frequently overlooked. And if this pallor is observed in the course of an acute or subacute pleurisy affecting a person of hitherto plethoric appearance, we may infer, with considerable probability, that there is a hemorrhagic exudation. But if the paleness comes on very slowly, during weeks or months, it may also be dependent on a simple sero-fibrinous effusion.

These processes naturally induce much emaciation and proportionate loss of power, though far more slowly than a hemorrhagic or purulent pleuritis. If the patients have been greatly debilitated by the long duration of the illness, some œdema of the subcutaneous tissue of the more dependent parts of the body may frequently be discovered. This is most commonly seen in purulent effusions, and thus it rarely extends beyond the ankles and the under-surface of the thighs. If the patient lies continuously on one or other side, the œdema naturally appears only on

the side on which he lies.   We must not, however, confound this
kind of œdema with an œdema limited to the affected side of
the chest, and which, whether it be extensively developed and
spread over the entire half of the chest, or only slightly manifest
and confined to certain spots on the side of the thorax, or near
the edge of the sternum, almost invariably justifies the diagnosis
that the effusion is purulent.[1]

The converse can never be established ; an effusion may be
purulent without the existence of any œdema of the wall of the
thorax. Œdema becomes evident when the accumulation of
blood in the veins of the pleura, and especially of the pleura
costalis, is so considerable as to decidedly hinder the return of
blood from the veins of the intercostal muscles and the skin.
But the more intense the venous engorgement the more abun-
dant will be the effusion of lymph corpuscles in the inflamma-
tion.   Thus it is easily seen how purulent effusions and œdema
of the chest-wall are results of the same condition—an intense
inflammatory venous stasis in the pleura.

It not infrequently happens that œdema of the affected side
of the chest-wall is combined with slight general œdema of the
subcutaneous tissue, and this often is the consequence of the
patient's lying on the affected side, over which, therefore, the
œdema is pretty generally diffused, and is simply disproportion-
ately great over the wall of the chest.   In order that we may
judge accurately of the relative properties of the two kinds of
œdema, the patient must be made to lie for some time on his
back, or, if possible, on the opposite side ; the general œdema of
the subcutaneous tissue will then be otherwise diffused, while
that which is special to the chest-wall will remain unaltered.
Wintrich very properly calls attention to the fact, that by
raising a fold of skin between the forefinger and thumb on the
affected side of the chest, and comparing its thickness with that

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[1] I formerly held that œdema of the subcutaneous tissue limited to the affected side
of the chest was a certain sign that the exudation was purulent, and I have only lately
somewhat modified this view, since the communication to me by Traube of his obser-
vation of a case where such œdema existed in a quite recent attack of pleuritis, and in
which, on puncture, a sero-fibrinous fluid was let out.   But even in this case the
pleural effusion afterwards became purulent.

of the corresponding part on the sound side, the œdema is readily detected by the greater thickness of the fold on the diseased side.

Also in the diagnosis of subcutaneous abscesses connected with the pleural cavity (empyema necessitatis), palpation affords important diagnostic aids (MacDonnell). The communication of the abscess with the pleural sac, in those cases in which, through the pressure of the exudation, etc., the tension has not become too great, or the diaphragm immovable, may be made out by the following signs : During inspiration the swelling becomes somewhat more flaccid, may even sink in, and shows fluctuation more readily ; then, again, during expiration, and especially during fits of coughing, or when, after a deep inspiration, the patient closes and strongly compresses the glottis, it quickly becomes more elastic, tenser, and harder, more distended, and its fluctuation is less evident.

In abscesses of the chest-wall which do not communicate with the pleural sac these changes are not observed ; on the contrary, even the distention may appear during inspiration.

In some cases of left-sided effusion we also notice a visible and palpable systolic pulsation in one or more intercostal spaces, giving an impression as if it were produced by the apex beat or by an aneurism, while, on closer examination, we find the heart displaced to the right beyond the right sternal margin. This symptom has been known for a very long time. Ballonius's [1] attention was called to it by an incorrect diagnosis. Le Roy [2] describes this pulsation thus. He says, in Aphorism 488 : "When, with these indications (of empyema) which we have given, a troublesome beating arises in a certain part of the chest, we must not hastily conclude that an aneurism is present ;" and in Aphorism 489, "When the collection of pus is so placed that the action of the heart or of the great blood-vessels makes an impression upon it, there sometimes arises the false appearance of an aneurism."

Walshe [3] has recorded, under the name "pulsating empy-

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[1] Epid., Lib. 2.

[2] Compare *Wintrich*, l. c., 259.

[3] Diseases of the Lungs, Heart, and Aorta, 1854, pp. 396–398.

ema," two cases of empyema in which there was very consid-
erable effusion on the left side, with the heart greatly displaced
to the right, and where post-mortem examination showed an
absence of any disease of the large vessels within the thorax;
in these cases, however (without the existence of an empyema
necessitatis), a pulsation which could be seen and felt was
observed under the left clavicle, extending as far down as the
mammary region, and this disappeared with the disappearance
of the effusion.

Traube [1] quite recently has described two analogous cases in
which the heart was found clearly displaced to the right; yet on
the left side, and external to the normal cardiac region, a number
of elevations were to be seen synchronous with the cardiac sys-
tole. In the second case observed by Traube, the systolic eleva-
tions were to be detected diffused widely in the second, third,
fourth, fifth, and sixth intercostal spaces. At the same time
the elevated spots exhibited evident fluctuation, and were forced
out more strongly during the act of coughing, and with greater
force than could be due to the action of the heart. But there
were also seen at the right of the sternum, in the fourth and fifth
intercostal spaces, corresponding with the right mammary line,
systolic depressions of the surface, each measuring from one and
a half to two inches in breadth.

These elevations must be accounted for by a locomotion of
the heart, seeing it is certain that the heart during the ventricu-
lar systole does not increase in volume, and cannot therefore
compress the fluid so as to give rise to the pulsations. As the
heart during the ventricular systole makes a movement from
right to left, it produces, each time, a yielding of the fluid in the
same direction, and so causes a bulging out of the intercostal
spaces.

The only question is, why these pulsations, if the above
explanation is correct, are so seldom observed, and hitherto
only in purulent effusions. Traube calls attention to the fact
that in these cases, as we learn from autopsies, suppuration of
the pleura costalis also takes place. The extensibility of some
parts of the intercostal spaces will thus be necessarily increased,

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[1] Verhandl. d. Berl. med. Gesellsch., II., p. 49 et seq.

and in consequence of this increased extensibility the displaced fluid can yield more easily than when the intercostal spaces are intact.

If this explanation were by itself sufficient, the phenomenon ought to be observed much more frequently than it really is. Traube looks for the further explanation in the presence of a co-existing pericardial effusion, which complicated both the cases that came under his observation. The locomotion of the ventricular cone of Skoda-Gutbrod must necessarily be more considerable when it takes place in a fluid which presents less resistance to the movement of the heart than under normal conditions, when the heart has to move along membranous walls to which it lies close.

Quite recently I have had an opportunity of observing such a case in the Charité, in which there existed, together with a considerable purulent pleuritic effusion, a pericarditis and a systolic elevation in the fifth and sixth intercostal spaces between the left mammary and the left axillary line. In this case, after previous puncture, I made an incision into the pleural sac in the fifth left interspace over the point of strongest pulsation.

Special Features of the Disease.

Nervous System.

Headache frequently accompanies the beginning of pleuritis, as it generally does that of every acute feverish illness. In children, however, the onset of the disease is in some cases marked by more severe head-symptoms.[1] In adults any considerable disturbance of the sensorium—a well-marked typhus condition, so to speak—is only observed in the rare cases of *pleuritis acutissima*.

Digestive Organs.

In the same manner the organs of digestion, in these cases, as in all fevers, are sympathetically affected. Vomiting of the contents of the stomach, largely mixed with bile, is a frequent symptom in the early days of the illness. At the same time there is loss of appetite, the tongue is thickly furred, and the bowels

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[1] *Henoch*, Journal f. Kinderkrankheiten, 1849, Bd. XIII.

are often constipated, though sometimes, at the commencement, there is a tendency to diarrhœa.

Urinary Organs.

The renal secretion is greatly diminished at the beginning of the illness ; it is thick and red, and its specific gravity rises to above 1.020 or even 1.030, while the amount secreted daily may not be more than three or four ounces.   At the same time the urine often contains a small, and sometimes a moderately large quantity, of albumen.   Rarely a very few hyaline cylinders, formed elements discernible only through the microscope, may be found.   Undoubtedly the most essential cause of this excessive diminution in the secretion of urine is the lowering of the tension of the arterial system, as demonstrated by Traube.[1] Since a great part of the lesser circulation is rendered impervious by the compression exercised by the effusion, an impediment is thus presented to the outflow of blood from the right ventricle and to its influx into the left ventricle ; venous engorgement also sets in, which the right ventricle, in its normal condition, is incapable of overcoming, whilst less blood reaches the arterial system, and, as a consequence of this, the pressure on the arterial walls is diminished, and coincidently there is a diminution in the quantity of urine secreted.   If, however, the pleuritic effusion is suddenly let out, as, for example, by puncture, the lung re-expands quickly, and the blood again circulates freely in the formerly compressed arteries of the lung ; thus, in a given time, a larger quantity of blood finds its way into the left ventricle, the arterial tension increases rapidly, while the pressure in the venous sys- tem as rapidly diminishes.   As the pressure in the arterial sys- tem increases, so the quantity of urine increases, its specific gravity falls, the albumen disappears, etc. The more exact exam- ination of the urine, as to quantity, quality, specific gravity, presence of albumen, etc., which appears absolutely necessary in clinical observations, if we are to speak of exact clinical investi- gations at all, is naturally doubly necessary in cases of pleuritic effusion. For increase in the renal secretion is often the first sign

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[1] Ueber d. Zusammenhang von Herz- u. Nierenkrankheiten, 1856, p. 45–54.

of reabsorption of the pleuritic exudation. If, after the thorax has been punctured, the quantity of urine does not increase, it is evident that the operation has been performed without lasting utility, and the prognosis is disturbed by the probable presence of some serious complication.

Physical Signs.

If we desire to set forth accurately the symptoms which are discovered in pleuritis by careful physical examination, we must follow the method adopted by Wintrich, and describe them separately in the different stages of the disease.

1. *In the commencement of pleuritis, when there is little or no fluid effusion.*

Inspection.

We notice a diminished expansion and elevation of the affected side of the chest, usually confined to the lower part, and seldom seen in the upper, which is proportionate to the severity, the seat, and the extent of the pain. At the same time the patients lie on the healthy side, and very often assume (especially children and young people), apparently to relieve the pain, such a position that the spine becomes curved laterally towards the sound side. This curvature is, however, easily rectified, either by the patient's own will or by slight changes of position prescribed by the physician. If the patient then lies straight, no abnormalities can be detected either by mensuration or palpation.

Percussion.

Percussion gives evidence of lessened expansion of the margins of the lungs, especially at the lower part of the affected side, and also on the sound side; the expansion of the margin is diminished, owing to the rapidity and shallowness of the breathing. Percussion on the affected side is sometimes painful, but it yields no noteworthy difference in the intensity of sound as compared with the healthy side.

Auscultation.

The respiratory murmur on the affected side is, pretty constantly, of less intensity and duration, corresponding entirely with the character of the breathing. One often hears a distinct friction sound, twelve or fourteen hours after the commencement of the attack, in one or other tolerably circumscribed spot, without any change in the percussion note or in the fremitus. I have noticed this in so many cases that I cannot agree with the statement of Wintrich on this point, that he has only observed this phenomenon four times, in cases of recent pleurisy, in twenty-two years. We shall scarcely ever fail to find this friction sound in recent pleuritis, if we look for it early and diligently in some circumscribed spot. Bronchophony and ægophony are not heard in these cases.

This friction sound was evidently known to Hippocrates, as we learn from the expositions of Wintrich,[1] and by direct comparison with the Hippocratic writings. He had already used the expression that the pleura "creaked like leather." This expression is highly characteristic. At other times we seem to hear rather a grating or scraping sound. Commonly the friction sound is heard both during inspiration and expiration, but one does not hear it continuously but with intermissions, apparently because in inspiration and expiration the opposed rough pleural surfaces do not *continually* rub against one another, but remain adherent to one another for a few moments, until a deeper inspiration tears them again asunder.

This pleuritic friction belongs to the few symptoms which possess an almost certain pathognomonic significance, and from its existence we can infer pretty decidedly the presence of pleuritis. The rubbing sound is most easily confounded with a rhonchus, which, indeed, is often also perceptible. A friction sound is, however, seldom so loud as such a rhonchus, nor will it be altered by coughing, whereas the rhonchus, after a fit of coughing, usually disappears or is altered.

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[1] L. c., p. 263.

Palpation.

The presence of a very small amount of fluid in the pleural sac is often made manifest by a diminution of the vocal fremitus. We can only be certain that an exudation of fluid has not yet occurred when we can feel the vocal vibrations of equal strength on both sides of the chest, or, perhaps, somewhat stronger on the right side. In this form of pleuritis, or in this stage, just as at the time when the effusion is for the most part reabsorbed, in the place where the pleuritic rubbing sound is heard, we may feel this same rubbing quite plainly with the hand. Indeed, the patient often feels it himself, and alludes to it as a "grating" or "jarring."

2. *When there is fluid effusion, without displacement of adjacent organs or expansion of the thorax.*

When there is no displacement of adjacent organs or widening of the thorax, the pleuritic effusion commonly does not rise, anteriorly, much above the level of the nipple.

Inspection.

The inspiratory expansion of the affected side is so regularly retarded and diminished, in comparison with the sound side, that even an inexperienced observer readily notices this. If the pain is severe, the affected side will expand still less, and the difficulty of breathing be considerable.

Percussion.

I quite agree with Wintrich that it is not possible, in adults, to diagnosticate with certainty, by means of percussion, the presence of eight or ten ounces of fluid in the pleural sac. It is difficult, however, to demonstrate this strictly, for when, in autopsies, we find a small quantity of fluid in the pleural cavity, it is scarcely possible to say how much of it may be due to post-mortem transudation. It is not until the level of the fluid effusion rises upwards, in the posterior and inferior part of the pleural

sac, to the extent of three or four fingers' breadth, that the percussion note, in this situation, becomes higher and duller ; and as the effusion extends upwards, the dulness increases in intensity. If the effusion becomes greater, and the patient retains the ordinary semi-recumbent position in bed, the dulness will gradually extend to the lateral region of the chest, and finally reach the anterior part, corresponding exactly with the increase of the effusion, which, following the simple law of gravity, when no special circumstance interferes, accumulates first in the lower and back part of the pleural sac, and gradually extends upwards and forwards. If such a patient be raised in bed we generally remark a considerable difference in the situation of the dulness, since it naturally assumes a lower limit posteriorly, while it rises higher at the side and in front.

Always, and with especial distinctness, in the ordinary semi-recumbent position of the patient, the percussion-note in the subclavicular region on the side affected becomes abnormally loud, deep, and tympanitic. The abnormal depth of the sound especially, and its tympanitic timbre, are very evident, and may be reckoned among the most characteristic symptoms of moderately great pleuritic effusions.

The following considerations are advanced in explanation of this symptom. The pitch of the sound heard on percussing over the lungs depends not only on the amount of the oscillating column of air, but also on the tension of the oscillating lung tissue. Wintrich was the first to clear up the latter point, by affording experimental proof that, as the tension of the parenchyma of the lung increases, the resonance becomes higher pitched. The first clinical observations in confirmation of Wintrich's theory have been communicated by Traube, in a dissertation drawn up under his supervision by Hermann Althaus,[1] and recently enlarged.[2] If we accept these views we must take it as established that as the tension of the parenchyma of the lung decreases, the percussion note becomes deeper, with diminution of their volume it becomes higher, *i.e.*, in other words, the pitch

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[1] De thoracis sono percussorio nonnulla. Berol., 16. März, 1857.

[2] Traube's gesammelte Beiträge, II., p. 852.

of the note stands in direct proportion to the tension, and in inverse proportion to the volume of the oscillating column of air. Now, as every pleuritic effusion compresses the lung somewhat, the amount of the oscillating column of air will naturally be thereby diminished. Consequently the resonance over the upper and anterior part of the lung, where the presence of effusion lying between the lung and the chest-wall does not come directly into consideration, will be higher pitched; but, on the other hand, the lung, in virtue of its power of contraction, will retreat before the effusion, and its tension will be therefore diminished, and the percussion note consequently rendered deeper. Now, if the diminution in volume and in tension be equally balanced, the sound under the clavicle remains unaltered; but if this is, as we have stated above, usually abnormally deep, it follows that in moderately large pleuritic effusions the decrease in tension must be greater than the decrease in volume. The diminished tension of the lung tissue, at the same time, explains, according to Traube's experience, the abnormally loud, tympanitic percussion note heard at the anterior-superior part of the affected side.

In superficial examinations limited to the anterior part of the chest, this abnormally loud, deep, tympanitic note under the clavicle of the affected side not infrequently leads to the supposition that the natural, loud, high note given out on the healthy side is abnormally dull, and that some disease of the lung exists here.

In many patients, especially when the pleuritis is double-sided, percussion in the infra-clavicular region gives rise to a peculiar symptom. The pitch of the note increases considerably during inspiration, and decreases considerably during expiration. This can only be explained by the influence which the tension of the lung tissue has upon the pitch of the note. For if the latter depended upon the volume of the column of air set in motion, the opposite would evidently be the case. The pitch would necessarily be raised during expiration, as the volume of the upper part of the lungs is then diminished.

Auscultation.

In this stage percussion is but slightly aided by auscultation. Where there is manifest dulness, there the vesicular breathing is weaker than usual, or the breath-sound may be indistinct; generally the vocal resonance is diminished over this part, bronchophony and ægophony are not observed, except occasionally in children, at the spot where the dull area passes into the resonant one. We often hear above the area of dulness, or (when this is limited to the back part of the chest) at the side or front of the thorax, a distinct pleuritic rubbing; this symptom affords evidence that the inflammation of the pleura has attacked parts which lie above the limit of dulness.

Palpation.

Over the seat of the pleuritic effusion the pectoral fremitus is naturally weaker than normal, and this affords a good diagnostic criterion in men, but it is not of much value in women and children, as in this case the vocal vibrations are, as a rule, too feeble, or altogether imperceptible.

3. *In Fluid Effusions Leading to Displacement of Adjacent Organs and Dilatation of the Thorax.*

Inspection.

Expansion of the chest on the affected side, even when the effusion has not reached its maximum, is very slight or altogether absent. This is quite independent of the circumstance that the presence of intense pain may still interfere with the mobility of the chest-wall. This more or less striking immobility of the affected side of the chest, as contrasted with the sound side, when accompanied by evidences of more or less severe co-existing dyspnœa, frequently enables us to diagnosticate, even at a distance, the probable presence of a large pleuritic effusion. The higher the fluid rises in the chest, the greater is the interference with the respiratory movements of the affected side, until these may be wholly annihilated.

When the effusion has reached a considerable amount, then the affected side of the chest becomes abnormally expanded, especially in the middle and lower regions; the intercostal spaces are widened, and in rare cases bulged externally ; the hypochondrium of that side is unnaturally prominent ; the nipple is abnormally distant from the central line of the sternum, and so is the scapula from the spine ; sometimes, indeed, when the whole pleural cavity is filled with fluid, the clavicular, acromial, and scapular regions are abnormally elevated on the diseased side.

All the above-mentioned symptoms are explained simply by the fact that the pressure within the thorax, which under ordinary conditions is less than that of the external air on the outer surface of the chest, increases with the increase of the effusion, and very often becomes much greater than it. The eye of the experienced physician detects these inequalities between the two sides of the chest sooner, and even more accurately, than can be done by instrumental measurement. Moreover, these appearances were familiar to the most ancient physicians, as is clearly seen in the writings of Hippocrates ; they are more fully described by Le Roy [1] and van Swieten. [2]

But the extraordinary high pressure exercised by the fluid not only leads to changes of form in the affected side of the chest, but also to displacement of the adjacent organs, so far as they are capable of displacement and not rendered immovable by pathological conditions. The diaphragm, in the first place, will be displaced downwards, and in consequence thereof the liver or spleen will also be displaced, as can be proved by palpation and percussion. These methods, conjoined with auscultation, afford more certain evidences of the existence of cardiac displacement than inspection, from which, when there exists no suspicion of heart-disease, we can only infer its probability. In clearly ascertained effusions into the right pleural sac the apex beat is observed to be carried to the left, far outside the left mammary line, while in left-sided effusions the systolic

[1] Vorherverkündigungen in hitzigen Krankheiten. Aus dem Französischen übersetzt. Leipzig, 1787, p. 135.

[2] Commentaria in H. Boerhave's Aphor., 1767, B. III., p. 57.

elevation or retraction is seen in one or other of the intercostal spaces to the right of the sternum.

Percussion.

The percussion sound is dull all over the thorax, wherever the effusion attains a depth of from an inch and a half to two inches between the lung and the chest wall; a tympanitic note is, however, to be observed at the lower part of the left side, in front and laterally. We shall refer more minutely to this presently.

If the effusion is so great that the adjacent organs are displaced, the percussion sound behind, at the lower part of the chest, will be absolutely dull, and even up to the supra-spinous fossa it will be found duller and higher-pitched than normal. The greater the amount of effusion, the higher up the dulness will reach. In the largest effusions it extends over the whole of the back of the thorax, with the exception, perhaps, of a small space at the upper part near the spine, and even here the dulness may be absolute if either the lung is completely compressed, or if, instead of being pushed back against the wall of the chest, it is compressed against the mediastinum. The percussion, moreover, must never be too strong, else it may easily become impossible to perceive the absolute dulness of the sound; for, with very strong percussion, either the sound lung or the ribs on the affected side are thrown into vibration, and then the percussion note no longer appears absolutely dull. Physicians have often disputed with me as to the presence of this absolute dulness; but they had simply percussed too strongly, and by weaker percussion they convinced themselves of their error. In some circumstances it will be advisable to combine palpation with percussion. In the most extensive pleuritic effusion an absolutely dull sound will be yielded by percussion over the whole of the anterior and lateral parts of the chest. This is, however, a very rare circumstance. We can recognize, with certainty, the rise of the fluid within the chest, by noticing that, in the semi-recumbent position ordinarily assumed by patients under examination, the lateral dulness

gradually increases simultaneously, both upwards and forwards.
The area of dulness, corresponding exactly to the position which
the fluid must assume in the pleural sac, in accordance with
simple physical laws, is always limited by a curved line, the
concavity of which is turned upwards and forwards towards the
sternum. From the free curved edge (if I may so call it) form-
ing the upper limit of the area of dulness, as far as the sternum,
.the percussion sound is simply intensely obscured. As the
effusion increases, the boundary of the area of dulness rises
in this fashion: if, for example, in an effusion on the right side,
the line of dulness begins at the right edge of the sternum on a
level with the third costal cartilage, it will reach to the second
rib in the right mammary line, and as high as the clavicle in the
anterior axillary line.

Above the limit of dulness—that is, over the lung tissue
which is not yet separated from the chest wall by a layer of
fluid—as soon as the fluid rises above the nipple, the percussion
note becomes abnormally high, dull, tympanitic; whereas, before
the fluid effusion had reached this extent, it was abnormally
deep, loud, tympanitic. The explanation of this change in the
phenomena elicited by percussion is not far to seek, in accord-
ance with what we have already stated above. If the effusion
has reached a definite amount, then the pulmonary retraction
has attained its greatest possible extent; now the pressure of
the fluid upon the lung begins to make itself noticeable, and
the diminution of the volume of the oscillatory column of air
overbalances the diminution of the tension; the sound, therefore,
becomes abnormally high, and naturally also less loud, but still
remains tympanitic, as the conditions for the development of the
tympanitic tone continue unchanged. The greater the effusion
becomes, the higher the area of dulness extends, and the more
is the lung compressed; at length, when the lung is pushed
quite against the mediastinum, and at the same time more and
more strongly compressed, it is only in the neighborhood of the
sterno-clavicular articulation that a region remains where the
sound appears indeed also dull, but high-pitched and tym-
panitic.

If the region which gives out a high-pitched, dull, and tym-

panitic note be limited to a very narrow spot, we frequently observe there also an exquisite *bruit de pot fêlé*. If we accept the general view that this cracked-pot sound is caused by driv- ing air, in jerks, out of a large space, through a narrow opening, then, in this particular case, the phenomenon is to be explained by considering that the effusion exercises the greatest amount of pressure on the main bronchi, and causes a very considerable narrowing of their calibre; the percussion blow drives the air backwards out of the still permeable lung, through the much compressed outlet, and thus the bruit de pot fêlé is produced. If the lung is completely compressed, dulness is to be found every- where in front. If the pressure to which the lung has yielded is not very great, we sometimes observe that the sound in the upper part of the affected side of the chest is again heard some- what louder, high-pitched, and tympanitic ; then again, after a longer or shorter time, it becomes absolutely dull. This symp- tom, at the first moment most striking, we observe after violent fits of coughing, and therefore, especially, after raising such patients for the purpose of examination, a process which often brings on violent paroxysms of cough. The obvious conclusion in this case is that the lung, being compressed by a slight and therefore easily overcome pressure, becomes again partially di- lated by the violent fits of coughing ; if the fit of coughing cease, then also the counteracting pressure against that of the effusion gradually disappears, the lung is again compressed, and the sound becomes the same as before the fit of coughing.

I had an opportunity of observing the first case of this kind two years ago ; the patient was a young girl, thirteen years of age, whom I treated in conjunction with Drs. Traube and Wilms. In the examination we were making preparatory to punc- turing the chest, she had a violent fit of coughing, and immediately afterwards the change in the quality of the percussion note in front was so striking that, for the moment, we abstained from puncturing. Traube's explanation of this occurrence, which I have just given, is all the more conclusive to me, because I have twice since observed the same phenomena, once in a tailor, nineteen years of age, and the other time in a girl, twenty-two years of age, both of whom had rather thin and yielding chest walls.

It must not be concluded because the effusion reaches a high level in the chest that it is necessarily on that account of great

amount. The lung may be prevented from contracting by reason of various kinds of adhesion, or by means of wide-spread infiltrations, by emphysema, by laryngeal stenosis, etc. ; in such cases, as the effusion increases, it quickly rises in thinner layers higher in the chest, without any remarkable displacement of other organs, without expansion of the chest, and without flattening of the intercostal spaces, etc. The consideration of these circumstances, taken in connection with the history of the case, and the course of the illness in the particular individual, will help us to a correct conclusion.

When we can determine with certainty, by the aid of percussion, a definite displacement of adjacent organs, this affords us valuable indications for judging of the quantity of the effusion. We can calculate by this displacement the direction of the greatest pressure, and more especially the different direct or indirect resisting power of the individual parts. As Wintrich very justly remarks, we cannot construct a pressure scale that shall be universally applicable to the individual organs ; the observed variations are too frequent and too numerous for this. The following statements concerning the displacements of which we are treating are drawn from my own observations and experience.

The effusion rarely reaches as high as the third rib, on either side, without the heart being displaced in the opposite direction ; generally a slighter amount of fluid suffices for this. This displacement no doubt takes place more readily in children and young people than in older persons. Sometimes in left-sided effusions, the lung having become adherent to the heart, the heart is drawn back with the lung away from the wall of the chest, and then it cannot be felt anywhere. In such a case we are apt, on account of the absence of the apex beat and the feebleness of the heart sounds, to assume, incorrectly, that there is effusion into the pericardium. In certain rare cases of left-sided effusion the fluid collects between the mediastinum and the external layer of the pericardium, so that the heart comes to lie embedded in the pleuritic effusion ; we must always bear in mind the possibility of such an occurrence in puncturing left-sided exudations. I believe Wintrich's idea to be erroneous that in ordinary displace-

ments of the heart this organ is to be regarded as a pendulum, and that it is not only displaced to one or other side, but also it is, at the same time, pushed upwards. In casual displacements to the right, the heart, with the mediastinum, is *simply* displaced to the right, while in right-sided effusions, first the mediastinum, and through it the heart, is carried to the left, and sometimes to such an extent that the cardiac dulness reaches as far out as the axillary line. In similar displacement from left-sided effusions the cardiac dulness very rarely reaches beyond the right mammary line. In these cases the heart is never at the same time displaced upwards; sometimes, however, when the diaphragm occupies a very low position it may be displaced downwards. The statement that the heart is displaced upwards, as well as laterally, in pleuritic effusions, just as it is in contraction of the lungs, is evidently based on the erroneous anatomical assumption that if one or other side of the diaphragm, and with it the liver, is displaced downwards, the suspensory ligament of the liver acts as a fulcrum around which the other lobe of the liver turns upwards. We have already observed, in speaking of the anatomical changes, that in extensive effusions which lead to depression of the diaphragm, the sound lung is compressed laterally by the mediastinum being forced against it, and this we can at any moment prove by percussion; for the tension of the lung is thus diminished, and the percussion sound over it becomes abnormally deep and tympanitic, while the diaphragm can now flatten itself to an extent which is impossible under normal conditions on account of the resistance which the lung offers.

In such cases the diaphragm supports the pressure of the whole weight of the mass of effusion, and besides this the counter-pressure which the elastic organs that have been displaced by the fluid are still capable of exercising. The amount of pressure is proportional to the extent of surface pressed upon, hence the right side of the diaphragm yields sooner than the left. In men the diaphragm is stronger and more resisting than in women.

If the diaphragm has contracted firm adhesions to the base of the lung, or to the liver, or to the corresponding organs on the left side, or if there should be considerable abdominal counter-pressure from the presence of abdominal tumors, meteoris-

mus, etc., then even very abundant pleuritic effusions will not be able to thrust the diaphragm downwards at all, or at any rate but very slightly. The fluid then compresses more strongly the other organs. As the diaphragm is pushed downwards on the right, the lower margin of the liver dulness descends at the same time, and may reach as low as the navel, or even lower. Sometimes the liver even appears quite thrust out of its position under the ribs, and loses all relation with the wall of the chest; as can be ascertained by the combined method of palpation and percussion.

Peculiar percussion sounds are afforded, even under normal conditions, in the region of the false ribs on the left side, and as these undergo characteristic changes in extensive pleuritic effusions it is necessary that we should here examine them closely. We have learnt from Traube's researches [1] that at the anterior base of the left side of the chest there is a region where the percussion note is tympanitic. This region is half-moon shaped, that is to say, it is bounded inferiorly by the margin of the thorax, and superiorly by a curved line whose concavity is turned downwards. This space, which for want of a better name we call the *half-moon-shaped region*, begins in front below the fifth or sixth costal cartilage, and extends backwards along the margin of the chest as far as the tip of the ninth or tenth rib. Its greatest breadth is from four inches to four inches and a half.

The sound in this region, in the natural condition of the stomach and large intestine, is distinguished from that of the lung above it not only by its tympanitic quality, but also by its higher pitch. We must not, however, percuss too strongly if we wish to define accurately this half-moon-shaped space, for with very strong percussion we may get a note of tympanitic quality even higher up than this.

Under normal conditions this semilunar space will be diminished by deep inspiration, as the lung is thereby increased in volume, and, with the diaphragm, descends lower. From this circumstance we can always conclude that the anterior inferior border of the left lung is movable.

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[1] Gesammelte Beiträge, II., p. 857.

Conversely, a considerable increase in the width of this space during respiration is usually connected with immobility of the lower border of the left lung, and is one of the most important signs of the existence of contraction of this lung.

The condition of this semilunar space is of the greatest diagnostic value in extensive left-sided pleuritic effusions. The greater such an effusion becomes, the more it presses downwards the diaphragm, and the smaller becomes the space of which we are speaking. If the effusion is not as yet very great, and the diaphragm therefore not yet actually displaced, we may find the percussion note in the anterior part of the chest obscured, while this semilunar space still remains unchanged in extent. If the effusion increases so as finally to displace the diaphragm downwards, then the area of dulness in the anterior chest wall not only spreads upwards but also downwards, and the semilunar space becomes diminished. This space may gradually disappear altogether, and this is usually the case when a considerable area of dulness appears in the front of the thorax above, with an abnormally high-pitched and tympanitic note. We may follow sometimes the area of dulness, after the semilunar space has disappeared, downwards beyond the costal margins. The dulness sometimes projects beyond the latter for two or three inches, and is then usually bounded inferiorly by a curved line, the concavity of which is turned towards the lower edge of the ribs. The extension of the area of dulness beyond the margin of the thorax can be observed in those very large effusions which push the diaphragm so strongly away from the thorax that it projects below the margins of the ribs with its convexity directed downwards. As a rule, under these circumstances, we can feel the bulged-out portion of the diaphragm below the lower margins of the ribs as a long, round, tolerably elastic tumor, in which we sometimes observe distinct fluctuation.

If the effusion diminishes in quantity we often first discover this by the reappearance of the semilunar space. In the case of excessively large effusions, naturally the first thing to disappear is the palpable swelling caused by the projection downwards of the diaphragm beyond the margins of the ribs, and the dulness thus produced, and not until after this has disappeared does the

semilunar space again become perceptible. This always happens in the following manner : first, a narrow strip of loud tympanitic percussion note is to be recognized below at the margins of the ribs, and as the effusion diminishes this increases more and more in extent in an upward direction.

The diagnostic value of this semilunar space is much too slightly estimated in manuals and text-books. Every experienced physician, however, who is familiar with the many difficulties attending the diagnosis of pleuritic effusions, and the errors to which it is exposed, will agree with me when I maintain that it is precisely because of the aid which the condition of this semilunar space affords us, that the diagnosis of a left-sided exudation, and the determination of the special relations prevailing in it, are so much easier than when the affection is situated on the right side.

From what we have here said about the depression of the diaphragm, it will necessarily follow that in extensive left-sided effusions the spleen, unless it should be fixed in its place by pathological adhesions, will be pushed downwards, and as a rule somewhat forwards, and thus become more accessible to percussion and palpation without the need of any increase in its volume. If the semilunar space has quite disappeared, then the spleen, if it is free to move, will be found lying outside the osseous chest wall, and its limits may generally be defined by percussion.

Finally, the only question which remains to be thoroughly examined is, whether in these extensive pleuritic effusions, changes in the position of the patient are attended with any alteration in the character of the percussion sound. Wintrich answers this question in the negative, and his view is defended in one of the most recent and popular Handbooks (Niemeyer-Seitz).[1] From my own experience I am led to conclude that this view is in most cases erroneous. It is necessary that the nature of the fluid in the pleural sac should be taken into consideration, for we are not concerned here with purely fibrinous exudations, as these never reach a great extent or lead to dis-

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[1] Lehrbuch der Pathologie u. Therapie, 1874, p. 290.

placement of adjacent organs. We must therefore bear in mind that the contents of the pleural cavity may be either purulent, or hemorrhagic, or fibrino-serous, and that the first and the last may be sometimes more and sometimes less thin and fluid ; it is, however, incontestable that dry, thick, purulent effusions, even when they have led to displacement of the adjacent organs, are sometimes so viscous that in changes in the position of the patient no change in the percussion signs takes place. It is not so, however, in other cases, but it is only when the sero-fibrinous effusion is very thin and fluid, or when it is a case of simple transudation, that we can establish by percussion the exact correspondence between the area of dulness and the column of fluid collected in the most dependent parts. In very large effusions, where there is absolute dulness from above downwards in front, we may observe sometimes, when the patient sits up, a small space at the summit of the chest, close to the sternum, where the dulness is not absolute, and where a high-pitched tympanitic sound is yielded on percussion. The cardiac dulness also moves somewhat further towards the sound side, and the liver or spleen dulness, as the case may be, extends lower down, etc. But in less extensive effusions, when in the ordinary semi-recumbent position of the patient absolute dulness does not extend over the whole of the anterior chest wall, but a resonant spot is still to be found at its upper part ; this spot, as we have already seen, descends lowest at the edge of the sternum, and is separated externally from the region of absolute dulness by a curved line, whose concavity is turned towards the sternum ; under these circumstances, if the patient is raised up, the upper margin of the absolute dulness reaches higher at the sternal edge by at most one intercostal space, while it reaches quite as low, anteriorly, as before. The dulness which in the semi-recumbent position, in correspondence with the horizontal level of the pleuritic effusion, stood highest in the deeper-lying parts of the anterior chest wall, now, when the patient is raised into the vertical position, stands perpendicularly to the axis of the body quite on the level of the exudation.

We do not observe a similar change in the area of dulness in thin purulent effusions, and in such sero-fibrinous or hemor-

rhagic effusions as are richer in fibrine. All we can do, as soon as the effusion has diminished—so that it is only when the patient sits up that the anterior chest wall, everywhere and in every position, is dull on percussion—is to distinguish three kinds of percussion zones: 1. The uppermost, high-pitched and tympanitic; 2. The zone of absolute dulness, which usually extends higher by an intercostal space at the margin of the sternum, and lower to the same extent in the mammary line, and runs perpendicularly to the axis of the body; and 3, A zone which occupies the space between the present and former boundaries of the area of absolute dulness, and within which it is more intensely dull on percussion than in the upper zone, but more resonant than in the lower one, and not tympanitic.[1]

The percussion signs here described admit of a simple explanation. In changes of position the fluid portion of the effusion sinks downwards, and it is only at the sternal margin that it extends a little upwards; its general level must, of course, be horizontal, and therefore, in the erect position of the patient, perpendicular to the axis of the body. But the denser parts of the effusion which adhere to the pleural surfaces, such as large masses of fibrine and pus corpuscles, especially when these latter are embedded in coagulated fibrine, in spite of the change of position of the patient, stick on to the pleural surfaces from which they are secreted, and thus give rise to the third percussion zone. Repeated experiments, by means of percussion, on dead bodies where analogous conditions obtained, have convinced me of the accuracy of the explanation here given.

It is sufficiently evident, from what has now been said, that in the diagnosis of pleuritic effusions percussion affords most important results, results which Piorry, in opposition to Laën-

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[1] The appearances here described I find in some particulars already alluded to by *Peter* (Leçons de clinique médicale, Paris, 1873, p. 532), but stated very differently. The curved line, which, with its concavity directed upwards and inwards, limits the area of absolute dulness in this direction, he terms erroneously "la courbe de Damoiseau." Damoiseau has never mentioned this line in his work (Recherches cliniques sur plusieurs points du diagnostic des épanchements pleurétiques, Arch. gén. de méd., Octobre, 143, p. 129 etc.), but has maintained the entirely false proposition, that in pleuritic effusions it is in the lateral regions of the chest that as a rule an area of dulness first appears.

nec, declares to be incomparably greater than those obtained
by auscultation.   There are only two cases in which percussion
may fail us: one is, when by reason of pre-existing adhesions the
effusion is prevented from gravitating to the lowest part of the
pleural cavity, but remains encapsuled, high up, in the place
where it was secreted ; the second is when an effusion has become
encapsuled between the base of the lung and the diaphragm, or
between the usually contiguous surfaces of two lobes of the
lung, when it is separated from the chest wall, on every side, by
permeable lung tissue.

Auscultation.

In extensive pleuritic effusions the auscultatory signs vary
greatly, according to the degree of compression which the lung
tissue has suffered, according to the amount of fluid which inter-
venes between the surface of the lung and the chest wall, at the
spot where one listens, and according to the adhesions which
exist.   When the lung tissue is but slightly compressed by the
effusion we generally hear *feeble breathing ;* when the compres-
sion becomes greater, but not so great as to separate the lung
widely from the chest wall, or to render the bronchia imper-
meable, we hear *bronchial breathing ;* finally, when the lung is
entirely compressed and driven far away from the chest wall by
a vast accumulation of fluid, so that the bronchia are imperme-
able, there may be entire absence of breath sound.   It is difficult
in individual cases to determine the precise cause of the various
auscultatory signs.

We can generally, in extensive effusions, at least in the poste-
rior part of the chest, observe a certain gradation in the signs
with the increase of the fluid.   When the effusion is already
great enough to cause displacement, we hear, but in a few cases
only, feeble breathing at the base, and vesicular breathing at the
upper part; much more frequently, however, the breathing is
already bronchial at the base and feeble at the upper part.   If
the effusion still increases in extent the breath-sound at the base
becomes weak and indistinct, and finally disappears altogether,
while above the breathing is bronchial.   This bronchial breathing
is especially audible in the immediate neighborhood of the ver-

tebral column above and below the spine of the scapula, where the lung is compressed against the chest wall, and it may often be observed here long after all other respiratory sound has disappeared from the posterior part of the chest; finally, it also may disappear entirely.

In the lateral region of the chest we generally observe feeble breathing or an entire absence of auscultatory phenomena, unless by reason of abnormal adhesions the compressed lung is here fixed to the chest wall; in that case bronchial breathing may be heard. The latter is, however, more frequently observed at the upper and inner part of the anterior wall of the chest, whither the compressed lung retreats before it is quite driven back against the mediastinum and the spine. In very large effusions, when the bronchia are completely impermeable, there is an entire absence of breath-sound in front also.

Metallic bronchial breathing, as Wintrich [1] describes it, I have never heard, and when I keep in view the conditions under which metallic bronchial breathing appears, I must altogether doubt its presence in simple pleuritis.

In these cases the vesicular breathing over the sound lung is unnaturally loud and sharp—"puerile" breathing it is designated by some authors, for want of a better name. This may sometimes be heard for several inches beyond the vertebral column on the affected side, especially when all other breath-sound has disappeared here.

In this stage of the illness we may have coarse mucous râles, ronchal, sibilant, and whistling, not only over the diseased but over the sound lung; they must be regarded as evidences of a bronchial catarrh, which, as such, has nothing to do with the pleuritis.

Friction sounds are scarcely ever observed in this stage of the disease, since in these extensive exudations the rough surfaces of the pleural folds are separated from one another by the fluid effused.

Bronchophony and ægophony are auscultatory phenomena frequently observed. As a rule these appear at the spots, and

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[1] L. c., p. 356.

some distance beyond them, where bronchial breathing is heard.
If we set out with the idea that bronchophony and bronchial
breathing are to be heard when there exists an unnaturally good
conducting medium between the trachea or the main bronchi
and the surface of the chest, and that ægophony is only an
unimportant variety of bronchophony, the appearance of bron-
chophony, under the conditions stated, is simply a natural
consequence ; the same may be said of the circumstance that it is
to be heard over a wider area than the bronchial breathing ; for,
the human voice being much louder at its place of origin than
the bronchial breathing, it is naturally transmitted farther. We
cannot, of course, hear bronchophony in hoarse persons, or in
those people in whom, on account of weakness or extreme dysp-
nœa, the voice has lost its resonance.   Ægophony has very
often been regarded as a characteristic symptom of pleuritic
effusion.   This assertion, advanced by Laënnec,[1] has indeed
been already contradicted by Skoda in the most decided man-
ner ; but still it has been constantly repeated. Wintrich leans
towards it, and quite recently Peter has presented himself as an
advocate of Laënnec's view.   In this he is certainly wrong.   Of
late years I have paid particular attention to this point, and I
have observed ægophony much less frequently than broncho-
phony, but both under the same physical conditions, and I can
only confirm the opinion that ægophony is an unimportant
variety of bronchophony, and is not a characteristic phenomenon
of pleuritic effusions.

Finally, auscultation is a valuable means of determining the
possible displacement of the heart.   Under normal conditions,
that is when there is no serious disease of the lungs or heart, the
heart-sounds are heard loudest to the left of the sternum,
between it and the parasternal line.   Should the heart now be
displaced to the right, the heart-sounds will appear louder at
the sternum, or, finally, to the right of that bone than to the
left.   In displacements of the heart to the left, the heart-sounds
at the left of the sternum become gradually more and more
indistinct, and finally almost entirely disappear there, while they

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[1] Traité de l'auscultation médicale, II., 319.

become more and more clearly audible at, and external to, the left mammary line.

Palpation, in the next place, will afford us valuable support in establishing the evidence of the displacement of adjacent organs; we can feel the apex-beat of the heart displaced abnormally far to the right, or to the left; we can feel the lower sharp edge of the liver, or the anterior or the inferior extremity of the spleen through the abdominal wall, and, if the diaphragm should be forcibly depressed quite beyond the osseous wall of the chest, we can recognize it as an elastic and frequently fluctuating tumor, either on the right or the left side. On the right side, in the latter case, a very peculiar state of things is observed, for beneath the swelling that can thus be felt, the whole mass of the liver lies outside the abdominal cavity.

The palpation signs which attend œdema, fluctuation, and pulsation on the affected side have been already alluded to.

Wherever the lung tissue is separated from the wall of the chest by a layer of fluid, there the pectoral fremitus, supposing it can be felt at all in the individual in question, is either much weaker than on the healthy side, or entirely absent; on the other hand, it is clearly perceived, and often in normal intensity, in those places where the compressed lung tissue is driven against the chest wall, when it, as well as the bronchia, is still partially permeable to air. If we make such a patient count aloud for some time, the hand applied to the spot feels the fremitus become steadily .weaker, and at last entirely disappear. Traube[1] first described this phenomenon, which he thus explained. In expiration the tension of the lung tissue becomes weaker and weaker, till at last the pressure of the effusion quite overbalances it, and the lung becomes entirely compressed. When this happens the fremitus naturally disappears entirely also, and does not reappear till, by inspiration, the tension of the lung tissue again exceeds the pressure of the effusion.

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[1] This statement had often been made by him before, and it was again alluded to at the meeting of the physicians of the Charité in the summer of 1874.

4. *When the effusion becomes absorbed, without leaving any deformity of the chest.*

We have long known from experience that the most extensive pleuritic effusions may be absorbed without leaving any kind of abnormal appearances which the most careful physical examination can afterwards discover. Indeed I know of many instances of cure of purulent pleuritic effusions, in which the so-called radical operation, *i.e.*, the opening of the pleural sac by incision, and the corresponding after-treatment, to which we shall refer hereafter, has effected a complete recovery, leaving no trace behind but the scar in one of the intercostal spaces. How this is brought about, and what takes place in the pleura after a recovery of this kind, we can only discover, subsequently, by the dissection of such patients. Hitherto I have not had the opportunity of making autopsies of such individuals, whose recovery in one way or other had taken place under my own eyes, and chance alone will enable us, even in a large field of observation, to collect experience bearing on this point.

If we inquire what are the signs which first lead us to conclude that the effusion is on the decrease, they are principally those derived from percussion. We learn very little at the beginning from inspection and mensuration. Wintrich rightly maintains that even a diminution in the circumference of the affected half of the chest, estimated either by measurement or by the eye, is no certain sign of the diminution of the effusion. For, in the first place, the affected half of the thorax may increase in circumference, while there is actually some diminution in the amount of the effusion, and this may arise through subcutaneous œdema of the affected side, or through increasing pliability of the intercostal muscles, while at the same time a stronger counter-pressure from the abdomen may be excited in an upward direction, through the relaxed diaphragm, and this may arise from various circumstances. Secondly, we sometimes find, after the removal by operation of a considerable quantity of the existing effusion, that the circumference of the chest remains the same; the diaphragm, however, rises higher, the lung, hitherto compressed, re-expands to some extent, and the

heart returns, at least in part, to its original position. But, thirdly, the expansion of the affected half of the chest may even diminish, whilst the effusion remains unaltered ; when, for example, the diaphragm yields more, or the heart and the mediastinum yield still more, or the lung, hitherto perhaps only partially pressed upon, is now surrounded by effusions, and reduced in size by stronger compression.

It is said that the muscles of the thorax play an important part in these relations. The intercostal muscles are said to yield quickly to the pressure of the effusion, then again regain their contractile energy and lessen the dimensions of the thorax. I have never observed an instance which would even afford an approximate confirmation of this assertion.

Inspection, however, may lead us to conclude with certainty that the effusion is decreasing, when it shows us that there is a manifest diminution in the expansion of the thorax, and of the distention of the subjacent hypochondrium, as well as a visible restoration of the heart to its natural position, and a retraction of the expanded intercostal spaces, connected with which we may perhaps also notice a stronger inspiratory expansion of the affected side of the chest. If the patient is quite free from fever, and not impeded by pain or dyspnœa, then the spirometer, as the capability of expanding the lung increases, will indicate an increase in the vital capacity of the respiratory organs.

Percussion affords much more certain evidence of the decrease of pleuritic effusion than inspection. A retrogression of the boundary line of the exudation, the other boundaries remaining unchanged, and especially the reappearance of the half-moon-shaped space, will at once enable us to infer that the effusion has diminished, which conclusion is, moreover, certain when the percussion boundary lines above, at the mediastinum, diaphragm, liver, spleen, and heart indicate, by their diminished extent, the return of those organs to their natural positions. If the retrogressing effusion had completely filled the pleural cavity up to its summit, then the first change to be observed is the appearance at the edge of the sternum of a narrow strip of high-pitched tympanitic resonance sometimes with, sometimes without, a cracked-pot sound. I have already explained how

this phenomenon is produced. If the process of absorption
continues, then the dulness on the affected side usually passes
through the dull and tympanitic state, to the condition of
natural non-tympanitic resonance. It is generally, however, a
very long time before all differences of sound have disappeared,
and the lower edge of the lung has again become freely movable.

The manifold variations in the auscultatory signs dependent
on the amount of the effusion, as well as on the height to which
it rises, will be manifest as the effusion disappears. Generally
there appears at first, where before scarcely any breath-sound
was to be heard, a very weak and quite indefinable indistinct
sound; this is succeeded by louder bronchial breathing, and later
on we hear indistinct vesicular breathing becoming gradually
louder and louder. Naturally we shall not be able to detect in
every separate part of the chest the transition from one kind of
breathing to the other, but the phenomena will vary greatly, as
well in any given case as also in different parts of the chest, and
in different stages of the progressive absorption ; but keeping in
mind the explanation already given as to the mode of produc-
tion of the auscultatory signs, we can have no difficulty in
assigning to these phenomena their true diagnostic value. It is a
long time before the vesicular breathing on the side affected is
heard quite as loud as on the sound side.

Characteristic of the absorption stage of pleuritic effusion,
and very rarely absent at that time, are the pleuritic friction
sounds which are to be heard louder and more widely diffused
in this period of the disease than in any other. They are often
to be heard in front, behind, and at the side ; we may feel them
at the same time, and patients will tell us that they also feel
them distinctly themselves. These friction sounds arise after
the absorption or outward discharge of the fluid portion of the
exudation, wherever the rough pleural layers rub against one
another, and this they may do for weeks, until either the asperi-
ties have become smoothed by friction, or, as happens much
more frequently, a gradual process of retrogressive metamor-
phosis sets in and leads to their absorption.

Another incidental auscultatory sound which is often heard
over the anterior and superior parts of the lungs when the

absorption of the effusion is already considerably advanced, consists in frequent trickling and creaking, moderately coarse vesicular râles, without any trace of cough or expectoration.

It was formerly thought that when these râles were heard we ought to infer the development of an infiltration of the pulmonary tissue, but experience has taught us that these râles often after a little time disappear, the patients steadily gain ground, and ultimately become quite well. Indeed when opportunities occurred subsequently of making autopsies in such cases where the patients had succumbed to intercurrent disease, it was frequently observed that no trace of any previously existing infiltration of the lung tissue was to be found. Traube,[1] resting his opinion on these observations, has maintained that the view hitherto held as to the mode of origin of these râles, viz., that they were produced by the air in inspiration and expiration making its way through the mucous secretion accumulated in the bronchia, is untenable. In cases such as we have just mentioned, in which there were no accumulations whatever of mucus in the bronchia, the râles, according to his view, arise in the following manner: The pressure of the effusion which still remains, though in less quantity, compresses the lung tissue, and with it a number of bronchial tubes; in deep inspirations this pressure is overcome, and the tissue of the lungs is expanded, the walls of the bronchia are separated from one another, and in this way numerous small spaces void of air are produced, into which the air from the neighborhood forces its way and produces a sound which in its sum represents these râles which we detect.

In my opinion Traube's hypothesis as to the mode of origin of these râles is the correct one, for it not only explains all the pathological appearances, but it also finds its analogy in the generally accepted explanation of the origin of the fine vesicular râles—the so-called crepitant râles (the *crépitation* of Laënnec).

We know that if we press a stethoscope, to which our ear is applied, against the surface of a lung removed from the thorax, and then allow the lung to return to its former volume, a fine, vesicular râle is to be heard, as may also be heard, sometimes, in the first few deep inspirations of healthy lungs, a phenomenon

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[1] Berl. klin. Wochenschrift, 1871, No. 26.

which is to be explained by the fact that the walls of alveoli
which contain no air become stuck together, and when they are
separated from one another this crepitant râle arises. We notice
the same sound pretty constantly in the first deep inspirations
after a pleuritic effusion is almost completely absorbed, and
there only remains still a slight diminution of the mobility of
the lung of the affected side, as the last remaining functional
disturbance.   Here also the crepitant râle may be explained sim-
ply by the fact that in deep inspiration, as the air first enters
certain alveoli, their walls are separated, and thus the fine vesi-
cular râle is produced, a mode of origin quite analogous to that
of the moderately coarse vesicular râle described above.   This
fine vesicular râle, which only appears when the pleuritic effu-
sion is almost wholly absorbed, must not be confounded with the
crepitant râle, which sometimes appears over the whole side of
the chest after the discharge of large quantities of effusion by
puncture.   This is not limited exclusively to the first deep inspi-
ration, and is a sign of the development of an œdema of the
lung, and other incidental auscultatory sounds have nothing
to do with the pleuritis, but depend on coexisting bronchial
catarrhs or infiltrations of the lung tissue.

Finally, also, auscultation demonstrates the retreat of pleu-
ritic effusions, by showing that the spot at which the heart-
sounds are loudest gets nearer and nearer, whether from the
right or the left, to its natural position, till at last no departure
from its normal situation can be perceived.

The palpation signs, in direct relation to the decrease of the
effusion, become also more and more such as they have been
described in moderately great and in slight exudations.   Strong
friction sounds may often at the same time be perceived by pal-
pation.   Palpation also affords evidence of the gradual return
of the heart, liver, spleen, etc., to their natural position.

5. *In diminution of the effusion, with consequent more or
less circumscribed retraction and deformity of the chest.*

Retraction and deformity of the chest, in the course of
chronic pleuritis, occurs frequently and is easily recognized.

Hippocrates knew and described it. Laënnec has described this "*rétrécissement thoracique*" more in detail. Partial circumscribed depressions are more common as a result of pleuritis than general retraction of the affected side. The numerical proportion of the latter to the former, as given by Walshe, is as 1 : 12 or 1 : 15.

The retraction of the affected half of the chest is always developed very slowly, and requires for its completion at least from four to eight months, often one or two years and more. Should it be general, then the affected half of the chest becomes by degrees so much retracted that its circumference usually measures from three to five centimetres less than that of the sound side. The greatest difference measured by Wintrich was eight centimetres. The ribs sometimes approach one another so closely that they come into actual contact, their external surface being thus turned downwards out of the vertical direction, and, their angle with the spine becoming acute, the anterior vertical dimension of the thorax is, in consequence, greater from the clavicle to the nipple and to the margin of the lower ribs than the lateral dimension.

The shoulders and the nipple are likewise depressed. The lower margin of the ribs on the affected side is drawn down, more or less, towards the pelvis.[1]

The scapula projects like a wing from the posterior surface of the chest. The lateral curvature of the spine is sometimes absent, and when it exists it is very various in its form. In most cases the convexity of the curve—which may be of larger or smaller size—is turned towards the sound side. Not so very rarely, however, when the contraction has reached its extreme limit, the convexity is turned towards the diseased side. The so-called *compensation curvatures* (one, two, or more) may be absent in certain cases of long standing *rétrécissement thoracique ;* they are, however, more commonly present, but scarcely ever in such regularity that curves and counter-curves deviate, in their projection, equally from the perpendicular.

The small circumscribed retractions and other deformities of the thorax, the result of secondary pleuritis arising in the course

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[1] *Wintrich*, l. c., p. 265.

of pulmonary consumption, gangrene of the lung, etc., are so various in their forms, and are so closely connected with the primary disease, that they cannot be described here in further detail.

If it is now asked, through what anatomical changes this *rétrécissement thoracique* arises, with or without spinal deformity, of which we are treating, we must answer that without doubt the false membranes produced by the inflammation constitute the most active cause; these become organized and act through the contractile process taking place in them, which finally converts them into pure cicatricial tissue. We must also admit, at the same time, that here and there, and especially in the production of the spinal deformity, the spontaneous position of the patient, and in other cases the effect of atmospheric pressure, etc., excite a subordinate influence.

By inspection and mensuration we can very easily detect the narrowing of the chest, especially when the patient stands or sits upright. After what has just been said, we need not again describe the appearances which are in this case observed. So far as the position of the heart is to be determined by inspection, we find it either in the place to which it was formerly forced by the effusion, and where it is fixed by adhesions, or it is nearly in its normal situation, or it advances to fill the space which the decrease of the effusion tends to leave vacant. In deep inspiration the retracted part of the chest is more or less retarded in its movements, while the portion of the affected side of the chest which has remained intact, and especially the sound side, makes powerful respiratory movements.

The percussion sound varies a great deal in proportion to the intensity which the contraction has reached on the affected side. Generally it is much the same as in moderately large effusions, only that the resonant areas remain unaltered for weeks, months, and even years. The drawn-up position of the liver and the dislocation of the heart can also be easily ascertained by percussion. But the most certain evidence is given of the contraction of the left half of the chest when the half-moon-shaped space is very evidently enlarged and the anterior lower edge of the left lung is immovable.

The auscultatory signs correspond with those furnished in moderately large effusions. Breath-sound is generally wholly absent at the base, anteriorly, laterally, and posteriorly ; above it is indistinct or bronchial in various degrees. These signs remain for weeks and months unchanged, before at certain spots in the upper parts of the lung natural breath-sounds return. Here and there the voice is strongly or weakly bronchophonic, and sometimes ægophonic. Frequently râles are heard which have no further diagnostic significance, or they are a sign of already existing infiltration of the lung tissue. Friction sounds are rarely heard, but where they exist they can be heard for a very long time.

Auscultation always affords important aid in detecting the cardiac displacement we have mentioned above.

Pleuritic membranes alone, when no fluid is to be found between them, do not diminish or destroy the *vocal fremitus*. The changes in form of the thorax and of the spine will naturally be more accurately distinguished by palpation than by inspection. Palpation also will readily detect the occurrence of a strong friction sound, as well as the setting in of *empyema necessitatis*, which frequently occurs in this stage of the disease, by the œdema of the affected side of the chest, and the fluctuations which accompany it.

We have here described in the most comprehensive manner possible the very various physical signs of this disease, as well as their diagnostic value in its different stages. We must now pass to the consideration of those complications and secondary affections which sometimes arise in connection with it.

Complications and Sequelæ.

Pleurisy may become complicated with almost any acute or chronic disease, but more frequently with some than with others.

In the first place, we must consider those cases in which pleuritis appears independently, but is followed by one or more local diseases. Pericarditis is one of the most frequent and important of these complications. It is developed by an extension of

the inflammatory process to the pericardium, and whether the inflammation of the pleura be simply sero-fibrinous, or purulent, or hemorrhagic, an analogous exudation will appear in the pericardial sac. The pericardial effusion sometimes reaches a greater amount than the pleuritic; sometimes the reverse is the case.

Endocarditis is rarely developed in connection with pleuritis, and when it is, it is generally closely associated with an attack of pericarditis. Hitherto I have only met with this complication of primary pleuritis in children.

The extension of the inflammation from the pleura primarily attacked to that of the side at first unaffected, is, as a rule, only observed when the former is the seat of tuberculosis. Hence we may establish with tolerable certainty this diagnostic fact, which is based on experience, that when pleuritis appears simultaneously *on both sides* it is commonly of tubercular nature. As, however, tubercular pleuritis seldom appears as a primary affection, the extension of the disease from one pleura to the other in primary pleuritis is of very rare occurrence.

Affections of the pulmonary parenchyma on the side diseased, especially peribronchitic and broncho-pneumonic processes—the latter, as a rule, of a caseous nature—must be regarded rather as sequelæ than as complications, and must be considered under that head. For it is only in the rarest cases that we shall succeed in showing that diseases of the parenchyma of the lungs are, in the true sense of the word, complications of primary pleuritis. As a rule, it is only when the pleuritis has partially subsided that we are enabled to convince ourselves of the existence of lung disease on the side affected. It is much more common to observe changes set in in the pulmonary parenchyma on the *sound* side, when pleuritis is at its height, and we may follow them through their development by physical examination. It can never be clearly proved that simple croupous pneumonia exists as a complication of primary pleuritis on the side affected; on the sound side it occurs but rarely—not so rarely, however, as people are inclined to believe. Another affection of the sound lung frequently accompanying pleuritis—the so-called pulmonary œdema—we ought, following

Traube's example, to regard as, in many cases, a kind of pneu-
monia, in which, however, the exudation that escapes into the
alveoli and the bronchia, in considerable quantity and extent,
has a prevailing serous character. The best designation for this
process is the one adopted by Traube, viz., *pneumonia serosa*—
a process which may easily and rapidly prove fatal by flooding
the bronchia with fluid, while the expiratory efforts are not
strong enough to free the air-passages by fits of coughing. The
patient is attacked, frequently after obvious exposure to cold,
and often without any such exposure, somewhat suddenly and
without premonitory rigor, with a feeling of great oppression,
which rapidly becomes unendurable ; orthopnœa is accompanied
with violent fits of coughing, which lead to the expectoration of
very large quantities of a thin, pale, rose-colored fluid, sometimes
of almost watery transparency, and highly albuminous. Slight
tracheal rattling is often soon observed, and when the expecto-
ration is insufficient, it rapidly increases as death approaches.
At the same time the frequency of the pulse is greatly increased,
the extremities are cool, and the temperature is sometimes some-
what raised (to 100° F.). If we examine the lungs we find no
decided changes on the side affected by pleurisy, nor any dul-
ness on the sound side ; but we have, everywhere, fine vesicular
râles, which conceal the natural breath sound. In autopsies of
such cases, we find the lung on the affected side showing signs of
more or less compression caused by the exudation, while the
other lung is very large and heavy—its cut surfaces present a
very œdematous appearance ; we also usually find in the lower
lobes one or more small spots, in which the tissue of the lung is
in an evident state of engorgement, and not infrequently in a
state of commencing red hepatization.

From experiments which I have made in late years, based on
the teaching of Traube, I believe that the pulmonary œdema,
which attacks the sound lung in pleuritis, must almost always
be regarded as a *pneumonia serosa*.

But the acute œdema which sometimes attacks the lung of
the affected side, after the effusion has been let out by puncture,
may be otherwise explained. In this case it will always be
found that very large quantities of fluid have been either sud-

denly or very rapidly discharged. In both cases the blood-vessels, whose walls have long been more or less compressed and probably damaged in their nutrition, have to bear a sudden increase of pressure, which is sufficient to cause a rapid outflow of blood-serum into the pulmonary tissue, and thus to give rise to œdema of the lung. Quite recently, in two cases, I have certainly seen œdema of the lung set in after puncture of pleuritic effusions in which only 1,600 and 1,500 cubic centimetres, respectively, of an hemorrhagic fluid were let out ; in these cases it was even manifest by auscultation that the lung which had been compressed shared in the œdema, and post-mortem examination revealed, besides the œdema, several spots in the same lung in which engorgement of the lung tissue was passing into the condition of red hepatization. But œdema of the lung on the affected side may arise in the same way as on the sound side, viz., through serous pneumonia. Œdema of the lungs is obviously identical with what the French have recently termed *albuminous expectoration*, and which some physicians supposed was caused by injury inflicted on the lung in paracentesis. This subject has been much discussed in the transactions of the Academy of Medicine of Paris. A recent work of Terrillon,[1] on this subject, containing a collection of the most important observations of French authors, shows that in France also they have given up the view that in these cases the lung has been wounded ; yet they appear in general—with the exception, perhaps, of Moutard-Martin and a few others—not rightly to comprehend this process.

Bronchial catarrhs must be mentioned as another complication of pleuritis, which may attack the sound as well as the diseased lung, and, when the effusion into the pleura is so considerable as to produce severe dyspnœa, the bronchial catarrh may aggravate the symptoms to a degree that may be dangerous to the patient. We must not omit to mention that with purulent pleuritis, especially, may be combined *inflammations of the mediastinum and of the peritoneum*. The latter, which is usually rapidly fatal, arises from the pus making its way into the

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[1] De l'expectoration albumineuse après la thoracentèse.   Paris, 1873.

abdominal cavity through the small lymphatics of the dia-
phragm. *Caries of the ribs* and of the *spine* setting in, in the
course especially of purulent pleuritis, is not so dangerous.

Hitherto we have only spoken of the complications of pleu-
ritis when it appears as a primary disease, and this was all the
more necessary, because nothing had been said in the earlier
chapters of the complications which we have been speaking of
here, whereas we had already mentioned, under etiology, the
other conditions under which inflammations of the pleura may
arise.

Thus we often see pleuritis appear under the influence of
some general morbid process, simultaneously with other local
processes, especially attacking the other serous membranes.
This applies especially to the acute exanthemata, as scarlet
fever, measles, small-pox, and to acute articular rheumatism.
We have already considered, in some detail, these relations, and
have pointed out how erroneous it is to place in this category
the inflammations of the pleura which occur in connection with
puerperal processes, and in so-called pyæmia. In connection
with the latter we must always be careful how we say that pleu-
ritis is a complication which arises through scarlet fever, or arti-
cular rheumatism, for it is quite as justifiable to regard the
pleuritis as a complication of the general disease.

In a third series of cases pleuritis appears as secondary to
other diseases, and especially to diseases of the pulmonary
parenchyma. We have already dealt fully with these cases,
and shown how inflammations of the pleura, and frequently the
most severe cases, arise as complications of quite circumscribed
pneumonias in the form of *pneumo-pleuritis.* It is, of course,
unnecessary to repeat here what has already been said.

Fourthly, we see inflammations of the pleura arise side by
side with other existing local affections as a purely intercurrent
disease, without any causal connection existing between them ;
the pleuritis in such cases must be regarded as a primary dis-
ease, in the causation of which the physical weakness induced
by the pre-existing malady, at most, may have had a share.

Of the *sequelæ* of pleuritis we must place in the foremost
rank the complete adhesion of the two pleural layers to one

another, and this occurs not so commonly after severe inflamma-
tions of the pleura and extensive effusions, but very frequently
quite imperceptibly and accompanied with very slight symptoms
of indisposition.

In consequence of the defective expansion of the lung caused
by these adhesions, inveterate chronic catarrhs of the bronchial
mucous membrane readily arise, and these, becoming more and
more severe, gradually give rise to an obstruction in the circula-
lation which may finally lead to a fatal issue. The diagnosis of
such cases, in which, as a rule, we are not in the least assisted
by the patient's account of himself, is very difficult, and is based
essentially on the diminished movement of the bony thorax, and
on the complete immobility of the lower limits of the lungs, as
ascertained by percussion, and in the absence of all other causes
for the general obstruction in the venous circulation.

The most frequent sequela of pleuritis is *caseous pneumonia*
in every variety of extent and course. In many cases also it
precedes the pleurisy, and in many it exists as a complication of
it. When the inflammation of the pleura leads to the formation
of false membranes, then we not infrequently observe a shrink-
ing of the affected lung with or without the development of
bronchiectasis; at the same time the sound lung frequently
increases in volume, which is commonly, but strictly speaking
incorrectly, termed emphysema of the lung.

Those diseases which are indeed the consequences of pleuritis,
but which essentially affect the tissue of the lung itself and its
functions, will be more fully dealt with by another author in
another part of this work. The same remark applies to the
amyloid degeneration of the kidneys, spleen, liver, and various
other organs, which arises in the course of purulent exudations
that are discharged externally, and in connection with which a
general cachexia arises, which for the most part ends fatally.

Diagnosis.

The diagnosis of a pleuritic effusion, based on the symptoms
given above, is, in the great majority of cases, an easy matter,
and, indeed, by the help of the morbid appearances which have

been described, it becomes tolerably easy to distinguish the separate forms from one another and their complications with other local or general diseases. It is true that the quality of the pleuritic effusion can only be ascertained with perfect certainty when it is artificially let out (by puncture or the like), or when it is discharged by a spontaneous opening.

If it comes to an *empyema necessitatis*, or if we have unmistakable signs of a communication with the lung or the bronchia, we have certain evidence that the effusion is purulent or ichorous.

If, in the course of acute pleuritis, with rapid and great effusion, a very striking anæmic condition suddenly appears, or if this happens in connection with *chronic pleuritis*, which is attended with the general and local symptoms indicative of the existence of caseous pneumonia or pulmonary phthisis, the conclusion is rendered almost certain that the effusion is hemorrhagic and tuberculous. An inflammation of the pleura is more readily confounded with some other disease the less prominently its symptoms stand forth, or the more they correspond to the symptoms of other affections. Blunders in diagnosis, however, will rarely occur, if our examination is conducted with great accuracy, if we follow the course of the disease with great care, and if we thoroughly attend to the history of the case. It would lead me far away from my present purpose if I were to bring forward, in this place, the symptoms of all the diseases with which inflammation of the pleura might possibly be confounded : *Intercostal neuralgia ; periostitis* of one or other rib ; *caseous inflammations of the tissue of the lung* and their results ; *pulmonary atelectasis* both in children and in adults ; *pneumothorax* and *pyopneumothorax ; abscesses of the chest wall ; aneurism of the great vessels within the chest ; tumors of the liver*, especially *abscesses* and *echinococcus cysts*,—neither of these can easily be mistaken for pleurisy by an observant physician. The knowledge of the fact that in extensive pericardial effusions, in consequence of the pressure that is thereby produced on the lower part of the left lung, the percussion note over the lower and back part of the left chest wall is rendered duller, and the breathing less vesicular, than on the right side, without the

existence of an inflammatory exudation in the left pleural sac, will, in the management of such cases of pericarditis, preserve us from diagnostic errors. When, however, it is clear that there is an accumulation of fluid in the pleural sac, it will be more difficult to determine whether it is of inflammatory origin or a simple hydrothorax. This question can, of course, only arise when there is general dropsy, and, therefore, especially after scarlet fever and in cardiac and renal disease. We know that an accumulation of dropsical fluid in one or other pleural sac may act directly as an exciter of inflammation, and so lead to pleuritic effusion. The question in such cases, therefore, is, whether we have to do with an exudation or a transudation. Our diagnosis will be assisted by always bearing in mind that transudations are usually double-sided, that they are slowly developed, and that they do not produce dyspnœa until the greater part of the lung tissue is compressed, and that they are not accompanied with fever. The latter is never absent in pleuritis, the advance of which is characterized by the obvious symptoms of cough, stitch in the side, and dyspnœa. Hæmato-thorax is distinguished by its sudden appearance, by its causes—wounds, aneurisms, etc., and by the subsequent development, six, ten, or fourteen days afterwards, of symptoms of inflammation of the pleura excited by it. It has happened to some of the ablest physicians, as, for instance Boerhaave, Corvisart, and even Laënnec himself, to confound pleuritis with extensive intra-thoracic tumors, especially cancerous growths, whether or not they have affected the mediastinum or the bronchial glands. Graves[1] was the first to pave the way for a more exact diagnosis, which has been more clearly laid down by Walshe and Stokes.[2] But even nowadays, when the physician scarcely ever neglects to apply auscultation and percussion to the elucidation of such cases, it is difficult to avoid error. The distention of the thorax, the displacement of adjacent organs, the absolute dulness of the percussion note, the absence of all respiratory murmur, of bronchophony, etc., may easily induce one to diagnosticate incorrectly

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[1] Clinical Lectures. Philadelphia, 1838.
[2] Dublin Med. Journal, Vol. 13.

the existence of an extensive pleuritic effusion. As a rule, pectoral fremitus may still be observed, in certain spots, over a lung infiltrated with cancer ; the area of dulness and the displacement of adjacent organs will not be so regular as in pleuritic effusions. If, however, the whole side of the chest is filled up by the new-formation, then a correct diagnosis will frequently only be possible after an accurate investigation into the history of the case, into the succession of the physical signs, and into the course it has followed ; while at the same time we keep in view the general symptoms of the case as well as the casual appearance of cancerous deposits in other parts of the body, which are accessible to direct observation.

But the converse mistake may be made; we may take an extensive pleuritic effusion for an intrathoracic tumor, especially if the patient, when he comes under treatment, is unable to give us any reliable account of the history of the case; if he has no fever, and is in a condition of the greatest possible prostration, while the displacement of adjacent organs, on account of abnormal adhesions, is slight and irregular.

About a year ago an excessively decrepid old man, seventy-five years of age, came into my department in the Charité, stating that he had only come to the hospital for the purpose of being transferred to an infirmary. His chief symptom was great shortness of breath. The right side of the chest was dull from apex to base, breath-sounds and fremitus were entirely absent. Heart and liver were scarcely at all displaced. There were several enlarged and indurated lymphatic glands in the right supra-clavicular region. The patient insisted that he had never felt ill, and had never suffered from pains in the chest, but only complained of exhaustion. The obvious diagnosis in this case was the existence of a malignant new-growth in the right side of the chest. To establish the diagnosis with certainty, I made an experimental puncture and discovered the existence of a large hemorrhagic effusion in the pleural cavity.

It is sometimes very difficult to distinguish between *croupous pneumonia* and an extensive pleuritic effusion. Every experienced physician will be able to confirm this statement, for he must have seen cases in which, if the diagnosis of extensive pleuritic effusion had been clearly established, immediate operative interference would have been demanded on account of the imminent danger to life ; and cases have been recorded in which

such a diagnostic error has led to the puncture of a lung infiltrated by pneumonia. Wintrich [1] mentions such a circumstance, and I myself, when I was a very young physician, witnessed another, in which a teacher of mine, now, alas, dead, whose diagnostic acumen I may, over his grave, justly extol, on account of impending suffocation proceeded to puncture the chest, but unsuccessfully; for all the morbid appearances were caused by pneumonic infiltration of the lung from top to bottom, without a trace of liquid effusion in the pleural sac. If we are acquainted with the whole course of the illness, and know that the attack was ushered in with a rigor which was immediately followed by continuous high fever and a temperature above 104° F., and this in the first week of the illness, together with the presence of rust-colored expectorations; certainly scarcely any one would diagnosticate a pleuritic exudation. Another important point in connection with the differential diagnosis between pneumonia and pleuritic effusion is, that in pneumonia the percussion note scarcely ever appears absolutely dull over the whole side of the chest, and scarcely ever is the area of absolute dulness bounded by that peculiar curved line, with its concavity turned upwards and inwards, as is the case in pleuritic effusions. A hepatized lung increases the pectoral fremitus or leaves it unaltered; pleuritic effusion weakens it or annihilates it entirely. In pneumonia bronchial breathing and bronchophony are generally heard louder and nearer the ear, and at the same time most frequently a crepitant râle is also heard, which is never heard in the effusion stage of pleuritis. The distention of the thorax, the tense or projecting state of the intercostal spaces, the extreme displacement of neighboring organs, and the more or less complete disappearance of the semilunar space, are peculiar to great pleuritic effusions.

It is very difficult to judge of the conditions which exist when a fibrous pneumonia is complicated with a very extensive pleuritic effusion, which we have described above as the so-called pneumo-pleuritis. But there are, after all, very few cases of pleuro-pneumonia, in which not a drop of fluid collects in

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[1] L. c., p. 299.

the pleural cavity; in such cases the erroneous diagnosis of co-existing pleuritic effusion can only be avoided by the greatest caution.

A most instructive case in regard to these diagnostic difficulties has been recorded by Traube.[1] The entire absence of expectoration, a condition which is almost always present with children, increases the difficulty of differential diagnosis in their case; the percussion sound may be absolutely dull over the whole of the affected side of the chest; no vesicular murmur nor indistinct breath-sound is to be heard; pectoral fremitus may not be felt at all, or only very feebly; the semilunar space may be considerably diminished, the heart considerably displaced towards the sound side, and yet we may only have to do with a pneumonia, without any fluid effusion into the pleural sac. How, in such cases of pneumonia, the almost entire absence of pectoral fremitus, the displacement of the heart, and the simultaneous diminution of the semilunar space, are to be accounted for, still requires a few words of explanation.

Traube has long maintained, in opposition to many others, that the vocal fremitus may appear weakened even over hepatized portions of lung. Its complete or almost complete disappearance he explains in this way, that in such cases numerous bronchia are occluded by fibrinous coagula, and the alveoli are abnormally stretched by the inflammatory products deposited in them. This last condition still further interferes with the permeability of the bronchia and the free communication between them and the trachea. Moreover, that in general the strength of the fremitus is diminished not only by liquid and gaseous accumulations between the pulmonary and parietal pleura, but also by anything which leads to constriction or occlusion of the bronchia, is best exemplified, according to Traube's experience, by certain cases of bronchial catarrh, in which, at the posterior and inferior parts of the thorax, so far as the mucous râles extended, the fremitus was found considerably weakened.

The displacement of the heart and the diminution of the semilunar space may be explained by the fact that the paren-

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[1] Ges. Abh., II., p. 854.

chyma of the lung is very greatly increased in volume through infiltration with the products of inflammation. Of course it is by no means every pneumonia that leads to increase in the volume of the lung, and it is only rarely that it reaches such an extent as to cause displacement of adjacent organs.

A careful consideration of the conditions here described is, however, always necessary, if we would avoid serious diagnostic errors.

Duration, Results, and Prognosis.

The average duration of an attack of acute primary pleuritis varies from fourteen days to three or four weeks. Death, however, sometimes occurs even during the first fortnight, when, for instance, it is a case of so-called pleuritis acutissima, the course of which we have already described under the head of Symptomatology, or when a very extensive sero-fibrinous effusion has become rapidly developed, and has led to fatal syncope. Trousseau attempts to explain this occurrence by referring it to torsion of the blood-vessels, especially of the aorta, while Bartels[1] believes that it is especially the great venous trunks that are here concerned, the permeability of which is endangered by the pressure of the effusion. The ascending vena cava particularly, where it perforates the central tendon of the diaphragm to reach the pericardium, and where it is firmly attached to the margins of the quadrilateral foramen, may, through the displacement of the heart, suffer an almost rectangular twist. Bartels has repeatedly observed this condition of the ascending vena cava in post-mortems of cases of left-sided effusion, and I have also seen it in three autopsies, and these were cases of left-sided effusion. I therefore believe that Bartels's explanation is the correct one, at least in the case of left-sided effusions, and hitherto I have never observed a case of death from syncope in right-sided effusions.

"Such a twist in the inferior vena cava must necessarily present a great impediment to the return of venous blood from the lower half of the body to the heart, and thus lead to an imperfect filling of the heart with blood. This deficiency in the

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[1] Deutsch. Arch. f. klin. Med. IV., p. 265.

natural blood supply of the heart will be all the more dangerous, because on the one hand a rapid diminution of the whole mass of blood is a necessary consequence of a quickly increasing pleuritic effusion; and, on the other hand, the pressure which the effusion exercises on the affected lung, as well as the loss of the vital movements of the lung itself, restricts and interferes with the conveyance of blood from the right to the left side of the heart. If in addition to these conditions, so unfavorable to the proper filling of the arteries of the body, there is superadded an accidental and even quite transitory disturbance of the circulation, as, for instance, a hasty movement of the body, a violent fit of coughing, by which the diaphragm may be suddenly driven upwards, and the twisted inferior vena cava, above the diaphragm, be quite compressed, such a disturbance would certainly suffice to bring about an absolute insufficiency of the arterial blood pressure, which becomes manifest either by the occurrence of serious fainting fits or is followed by immediate death.''

In a third series of cases, an œdema of the sound lung may bring about a fatal issue even in the first fourteen days of the illness.

If an acute primary pleuritis terminates in recovery within from two to four weeks, the effusion into the pleural sac cannot have reached any considerable height. For in the latter case the acute pleuritis gradually becomes chronic, and may possibly require many months or years for complete recovery. It is a very rare circumstance for an inflammation of the pleura, with great effusion, to end in complete recovery in four weeks. A remarkably rapid absorption of the exudation may be observed in connection with intercurrent diseases, which are attended with abundant watery secretions, as is especially the case in cholera.

A secondary acute pleuritis, even when attended with extensive effusion, may run its course in the same way as a primary attack, and end in complete recovery; but this result is not common. As a rule, no matter what the primary disease on which the pleuritis has supervened, its appearance may be regarded as the beginning of the end; if, for example, it occurs in a patient suffering from phthisis, the respiration, already

greatly embarrassed, becomes so impeded that death results
from suffocation, or the patient, already debilitated by fever,
with the fresh escape of nutrient juices, sinks from utter exhaus-
tion.   A more detailed description of all the possible cases in
which an acute secondary pleuritis may lead to a fatal issue
would carry us too far from our present purpose.

The duration of chronic pleuritis, primary as well as sec-
ondary, varies from eight weeks to a year, up to five, ten, and
eighteen years.   Sometimes a pleuritic effusion will advance
slowly during many weeks, accompanied with a moderate
amount of fever, and usually the absorption of the fluid will
extend over a still longer time as it proceeds more slowly than
the effusion.   So long as the situation of the fluid is fluctuating
we must not give up the prospect of a favorable issue ; yet sud-
den death is always possible from œdema of the lungs, or from
syncope.

If, however, a considerable effusion, after continuing for four
weeks, remains stationary for a longer period, we may antici-
pate that the course of the disease will be protracted, because
either the effusion will be surrounded by structures through
which absorption is almost or quite impossible, or the effusion
itself is little or not at all prone to absorption, or finally, because
the inflammation is associated with incurable disease of the
pleura, as, for example, tuberculous infiltration.   The absorp-
tion of the effusion may, for example, be rendered impossible,
because the pressure on the surrounding tissue is so great that
the orifices of the lymphatics become completely compressed,
and therefore impenetrable.   In this case, if a portion of the
fluid is let out by puncture, the hitherto compressed lymphatics
will again become permeable, and the absorption of the remain-
ing portion of the effusion will follow rapidly.

In another class of cases thick, non-vascular false membranes
prevent the absorption of the fluid contents of the pleural
cavity.   These, however, even after many months, may slowly
become vascular, and thus the absorption of the existing fluid
effusion becomes possible.

Hemorrhagic effusions, as we have already seen, are, for the
most part, of tubercular nature, and they lead sooner or later to

a fatal issue. We have already pointed out, in treating of the pathological anatomy of pleuritis, that purulent effusions only terminate favorably, unless relieved by operative measures, when the pus is insensibly discharged outwardly. We have also already alluded to the dangers which arise when it penetrates into the bronchia. Should the pus force an exit through one or other of the intercostal spaces, and give rise to an *empyema necessitatis*, or should it sink towards the abdominal cavity, and break through some spot there, a fatal result usually follows, though it may not be in some cases till after long years of suffering. Many cases are on record of thoracic fistula, as a consequence of purulent effusion, in which patients have lived for ten, fifteen, or seventeen years.

In cases of chronic pleuritis, if after some time the fluid is not absorbed, and recovery does not take place, almost the only resource left to us in order to ensure a complete cure is an operation, either puncture or incision, the former in sero-fibrinous, the latter in purulent effusions. If the patients recover without operative interference, the recovery is imperfect, as it is always attended by a *rétrécissement thoracique*. This happens if the effusion, sooner or later (perhaps not till after months, or even two or three years) becomes partially or entirely absorbed, and the lung re-expands somewhat, and the chest wall is sufficiently elastic and yielding to allow of retraction. The breathing capacity of the lungs which then exists is sufficient for quiet occupations, and it is still further augmented by the enlargement and vicarious activity of the sound portions of the affected lung, and especially of the lung on the sound side.

The prognosis can readily be deduced from what we have already said. It is of the first importance in every case of pleuritis to be watchful in this respect, for we never know whether the course of the case may not be quite foudroyant, or the effusion very great, or whether a fatal result may not be possible in consequence of œdema of the lung or syncope. As this result is to be feared at any moment in cases of great effusion, our prognosis in such cases should be carefully guarded. The prognosis in primary acute pleuritis is on the whole favorable when it attacks people of healthy and strong constitutions,

who have no hereditary tuberculous tendencies, and when the general symptoms are not severe, and when after the first three or four weeks the commencing signs of absorption are observed, unaccompanied with any tendency to contraction of the chest. Should such cases be complicated with pericarditis, endocarditis, or pneumonia, these complications, and not the pleuritis, may possibly require a less favorable prognosis. On the other hand, the prognosis is unfavorable in all cases of chronic and secondary pleuritis, in cachectic persons of bad constitution, or in those who have been brought low by other illnesses, and in anæmic and tuberculous persons, especially when the effusion is purulent or ulcerous. In the latter case a fatal result is almost certain. Often, however, we can only decide with certainty in a later stage of the illness whether the pleuritis will become chronic or attended with serious complications. The following are always unfavorable signs : 1. A double-sided pleuritis, as it almost always indicates tuberculous disease of the pleura. 2. Continued high fever. 3. Rapid increase of the effusion, accompanied with high fever and with great displacement of adjacent organs, unless, after a course of from four to six weeks, signs of commencing absorption are observed. 4. Symptoms of impending suffocation. 5. Discharge of the pus either into the bronchia, with the simultaneous production of *pyopneumothorax*, or externally through one of the intercostal spaces. 6. The rapid increase of an effusion which has for a long time remained stationary, because in that case the pleuritis, as a rule, has assumed a tuberculous and hemorrhagic character. 7. A rapid return or increase of the effusion after spontaneous or a single or repeated artificial discharge of the same, especially where the quality of the discharged fluid degenerates and becomes purulent, bad-smelling, ichorous, chocolate-like, etc.

Treatment.

There are many physicians even nowadays who adhere to the expectant method which came into vogue now more than thirty years ago, and who recommend that pleuritis should not be submitted to medical treatment unless special symptoms are

present which threaten life. They assert that inflammations of the serous membranes — pleuritis and pericarditis—unless attended by very great effusion, are not dangerous diseases, and will get well of themselves. What infinite mischief has the adoption of this view already inflicted on such patients ! It is only necessary to have observed one case of adhesion of the layers of the pleura or of the pericardium ; it is only necessary to have once seen with observant eyes how such patients inevitably, and with the direst sufferings, are condemned to certain death, to induce us to strive with all our might, in every fresh case of pleuritis or pericarditis, to quickly reduce the inflammation, and bring about as complete an absorption as possible of the deposited exudation. To attain this end, we shall naturally endeavor to avail ourselves of the experience of our predecessors, many of whom were endowed with pre-eminent powers of observation, and have handed down to us the fruits of their practical experience. They also adopted the method to which our reflections lead us : a severe antiphlogistic treatment, combined with means which promote absorption. Only when there is very high fever and very rapidly increasing effusion will venesection,[1] to the extent of from six and a half to nine and a half ounces, be advisable. Generally, in the beginning of the illness, the application, once or oftener, of from eight to twelve cupping-glasses will suffice—in the case of children, leeches—combined with the internal administration of digitalis and calomel, the former to act purely as an antiphlogistic, the latter, in addition, to promote absorption.

I am usually in the habit of giving a grain each of digitalis and calomel until either a considerable lowering of the pulse or

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[1] To enter more fully here into the question of the utility of bleeding in general, and in pleuritis in particular, would carry me too far away from my subject. The oldest writers, from Hippocrates, Galen, Aretæus, Aetius, Alex. Trallianus, the Arabians, then Sydenham, Huxham, Callisen, Baglivi, Dover, and Stoll, down to Bouillaud, Chomel, and Walshe, have discussed this question minutely in their works. Opinions as to the utility and occasional application of bloodletting have, during the last twenty years, been entirely transformed and placed in a new light as compared with former times. The pros and cons would be out of place here. Suffice it to remark that I am of those physicians who even in the present day do not shrink from bleeding in suitable cases.

symptoms of commencing salivation demand the cessation of one or other of these drugs, or until the intensity of the fever has considerably abated. Digitalis and calomel are contraindicated if, from the first, severe gastric complications coexist, if the tongue is thickly furred, if the appetite fails, and if diarrhœa be present. We must then confine ourselves to the internal administration of nitrate of potash or soda, dissolved in some mucilaginous decoction, in the proportion of ninety grains to four fluid ounces of the menstruum, which medicines, when the fever is slight, are usually sufficient from the outset, or, when even these cannot be borne by the digestive apparatus, we can fall back upon the milder-acting acetate of potash.

In order to obtain the effect of mercury without disturbing the digestive organs, mercurial ointment may be rubbed into the skin, as formerly recommended by Laënnec. This plan should be carried out very methodically, by rubbing in fifteen grains of mercurial ointment every two hours, day and night, into the following parts in regular succession : first, on the inner surface of the upper part of one and then of the other thigh ; next, in the same way, on the inner surface of the lower part of the thigh, then on the upper arm, and then on the forearm. It is better to leave the skin of the trunk untouched, as generally other outward medications may have to be applied here. These frictions with gray ointment are to be continued until the first symptoms of salivation appear, then it is to be discontinued.

If we see reason to avoid further abstraction of blood by cupping, we can continue a decided antiphlogistic plan of treatment, in the beginning of pleuritis, by dry cupping and by blistering. Both these expedients act by dilating the vessels of the skin, and so diminishing the over-distention of the vessels of the pleura. We should remember never to place blisters on the back or on that part of the surface of the chest on which the patient is in the habit of lying, because when he lies on the sore part he suffers constant pain. It will generally be sufficient to let the blister remain on for three hours, whereby we obtain an intense derivation to the skin without the production of large vesications, the patients suffer less pain, and the spot on the skin is soon again in a condition to bear the application of another

blister. In very sensitive persons it may be necessary sometimes to abstain altogether from the application of blisters, and to supply their place by the more frequent use of sinapisms, as had already been advised by Celsus.

Some individuals cannot even endure the pain of a sinapism ; only last summer I experienced this in the case of a very delicate lady, whom I attended, with a very large pleuritic effusion, and who, when a mustard plaster was applied, soon complained of the most unendurable pain, and finally fell into the most violent convulsions.

I must mention here that the mustard papers used in private practice in Berlin, in which mustard is glued upon a sheet of paper, have the disadvantage, compared with the ordinary mustard plaster, that they often, after they have been kept on a very short time, produce such intense pain that they have to be removed, though the skin is very little or not at all reddened, and before, therefore, the object of the sinapism is attained. I cannot say on what this torturing effect of the mustard papers depends.

The application of dry-cupping, of blisters, and of mustard plasters is also indicated when, from the first, the attack of illness is not accompanied with very violent fever, and their continued use is attended with the best results when the pleuritis has become chronic, or when occasional pains in the chest indicate that inflammatory conditions still exist, or that the absorption of the effusion proceeds very slowly. In this case it is best to use *flying blisters*, *i.e.*, we apply a cantharides plaster, the size of the palm of the hand, to the front or side of the chest, and as soon as the sore produced by it is healed, we put on a fresh blister in another place, and so on, as many as six or even eight, sometimes one after the other. In this stage of the disease it is also often of use to paint the affected side of the chest with tincture of iodine, which naturally produces the same effect, viz., a great distention of the vessels of the skin, and a consequent draining of the pleura. These applications of iodine paint are apt, however, to produce, if used too frequently, or in too great strength, very severe pain ; it is always better to discontinue it for two or three days if the skin becomes broken in any place. With these precautions I have used the tincture

of iodine in the most extensive manner, and with the utmost
success.

Amongst the other antiphlogistic remedies which we may
have to take into account in the treatment of pleuritis, we have
yet to mention the application of cold, large doses of quinine
and strong aperients.

The application of cold bandages or ice-bladders in pleuritis,
I do not in general consider advisable, because the cold very
often brings on violent fits of coughing, and thus an increase of
the inflammatory action may easily be induced. But after the
removal of the effusion by operative measures, either puncture or
incision, I am in the habit of applying a small ice-bladder over
the situation of the wound for twenty-four or forty-eight hours.
Large doses of quinine will perhaps produce a reduction of the
temperature for a short time, but it can scarcely exercise a really
beneficial influence on the affection of the pleura itself.

On the other hand, the administration of drastics in the treat-
ment of pleuritis is, in many cases, most successful. We must
not give them at the very onset of the illness, as at that time
they are without effect ; but if the inflammatory process has
reached its height, and the fever is beginning to decline, then the
latter will be still further rapidly reduced under the influence of
powerful aperients, while the pleuritic effusion diminishes con-
siderably in quantity. I prefer in these cases to use the com-
pound infusion of senna,[1] of which I give from four to six table-
spoonfuls, so as to secure from six to eight or ten watery motions
daily. We continue with this for two or three days consecu-
tively (unless violent gastric disturbance, or a very feeble condi-
tion, such as is commonly present, especially in secondary pleu-
ritis, forbids the use of strong aperients), and then omit a day,
or we give the compound infusion of senna one day, omit it the
next, recommence the third, and so on.

The use of emetics recommended by Riverius, Morgagni,
Tissot, Stoll, and by Laënnec even, for a time, and the prepara-
tions of antimony, have been rightly discarded. In children,
where pleuritis is very often complicated or secondary, the use
of antiphlogistic measures requires special caution, otherwise

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[1] An infusion of senna, containing also Rochelle salt and manna.

serious collapse may suddenly present itself and require the administration of stimulants.

Sometimes there are certain symptoms which require special therapeutic management. Should the pleuritic pain be very severe, we must try to relieve it by dry or wet cupping applied especially to the painful spot, or a blister, or a sinapism, or by rubbing in warm oil, to which, if necessary, an equal quantity of oil of henbane has been added, and covering the side with cotton wool. Should all these means fail to subdue the severity of the pain, the best results sometimes follow the application of warm bandages, as long ago recommended by Hippocrates. It is better not to use cataplasms for this purpose, as their application is always inconvenient, tedious, and somewhat messy, but to lay on the painful side compresses wrung out in hot water instead, and cover them with some water-proof material. They will thus be kept for a long time quite warm, and will not require to be renewed more than three times in twenty-four hours.

With the relief of the pain the dyspnœa will disappear, supposing that it has been really caused by it. But if it is caused by the amount of the effusion, then it is time to think of its removal by operative procedure. We must never give opiates in acute pleuritis to relieve the dyspnœa, and even in chronic cases of secondary pleuritis it can only be given with the greatest caution, for the dyspnœa which may already exist is only too frequently suddenly aggravated by opiates. So, also, if we determine to give opiates because of persistent sleeplessness, they must be administered with special caution ; the best form is the subcutaneous injection of morphine. If this does not increase the dyspnœa and the fever, then the whole course of the illness is favorably influenced by the rest which the patient procures. We may sometimes, however, succeed in getting rid of this sleeplessness by placing the patient in a cool, quiet room, and taking care at the same time that the bowels are regularly evacuated every evening.

If the irritation of the cough is very severe, we should give internally a few drops of bitter almond water,[1] or small doses of

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[1] The German bitter almond water is a strong preparation prepared by distillation. One thousand parts contain one part of hydrocyanic acid.

extract of henbane, and when these means fail, some morphine, which it is still best to apply subcutaneously. So long as the pleurisy is accompanied with fever, the patient must be kept in bed, fed on milk and broth, to which, as the fever subsides, the yolks of one or two eggs may be added, also some white bread and stewed fruit. In primary pleuritis, while the fever lasts, meat and wine must be entirely avoided. But if the effusion becomes purulent, or if the pleurisy was from the first secondary, we cannot continuously withhold meat and wine even though the patient be feverish. Effervescing drinks are not well borne, as the carbonic acid which is thus conveyed into the system increases the dyspnœa.

If the fever is subsiding, or if it has quite disappeared, while a considerable effusion remains in the pleural sac, we must adopt means to promote its absorption. Sometimes, and especially when there still remains a certain amount of feverish excitement, most excellent results are obtained, as we have already mentioned, from the use of drastics, as well as from the external application of blisters, sinapisms, and painting with iodine. If the fever has quite disappeared, we may try the effect of diuretics. Rarely, however, do these alone produce a decided result. Apart from digitalis, to which some erroneously attribute a direct diuretic action, whereas its diuretic effect is only secondary to its influence on the cardiac muscle and the walls of the blood-vessels, remedies like acetate of potash, acid-tartrate of potash, boro-tartrate of potash, and the vegetable diuretics, are by themselves of little efficacy. On the other hand, their action is often very striking if they are given in combination with tonics. I have constantly seen the most successful results, in the way of increase of diuresis and diminution of the effusion, from a combination of decoction of cinchona with acetate of potash. We must, however, when we begin the use of these remedies, watch the temperature closely, as occasionally, if the fever is not quite extinguished, it may be renewed by this medicine. Should this be the case, we must, of course, discontinue it. A very favorable effect is also produced in this stage of the disease by pills of muriate of quinine and squill (one grain thrice daily). At the same time, squill is apt to irritate the stomach.

I have repeatedly given iodide of potassium internally (from sixty to ninety grains in four ounces of fluid—one tablespoonful three or four times a day), but I have never observed any marked result in the absorption of the effusion.

Diaphoretics are scarcely ever used now, as they have long been found useless in promoting absorption.

Finally, upon the recommendation of the late F. von Nie- meyer, who saw a pleuritic effusion, which had long resisted all treatment, quickly diminish when the patient was submitted to Schroth's method, i.e., placed upon as dry a diet as possible, and the use of liquids almost entirely prohibited, the attention of many physicians was directed to this treatment.[1] By means of this method, Pimser, in eighteen cases, obtained eleven com- plete successes.   He limited the food of the patient to lean roast veal and stale rolls, kept them two days without any drink, and not until the third day allowed half a pint of red wine, on the seventh and eighth day a whole pint.   The urine decreases con- siderably under this treatment.   The decrease of the effusion is said to be observable even from the commencement of the treat- ment.   Not many patients will have the will and the energy necessary to submit to such a cure, which is seriously injurious to the entire constitution, without it being at all probable, from the observations hitherto made, that the absorption of such effu- sions could not be brought about in some other way.

If the effusion is reduced to a minimum, or there only re- mains perhaps an imperfect expansion of the lower margins of the lungs, then complete restoration may usually be secured by a prolonged residence in a high-lying Alpine health-resort, such as Engelberg, Stachelberg, Tarasp, etc., or in some of the higher localities on the lake of Lucerne, or at Meran, Botzen, Kreuth, Aussee, and such little places, or even on higher spots in the North-German mountains, in short, wherever, on account of the rarity of the atmosphere prevailing there, patients are forced imperceptibly to take deeper inspiration, in order that they may inspire an equal amount of oxygen in a given time.   By means of this respiratory gymnastic the last residua of former exuda-

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[1] *Niemeyer-Seitz*, Lehrbuch der Pathologie und Therapie, Vol. I., p. 298.

tions become absorbed, and the existing adhesions between the pleural surfaces are set free, while the invigorating mountain air itself rapidly and visibly strengthens the constitution of the patient convalescent.   Even when the absorption of the effusion proceeds uninterruptedly, yet patients will frequently complain of a decided sensation of oppression and tightness on the chest, which is especially felt during deep inspirations, coughing, and yawning, and this does not disappear till the very last physically discoverable trace of effusion is gone.

But in .other cases of acute and chronic pleuritis, when the effusion is sero-fibrinous and hemorrhagic, as well as when it is purulent, we have been taught by very numerous instances that we should not hesitate to remove the fluid by operative measures.   Ever since the time of Hippocrates, the operation has often been performed by the ancient physicians and surgeons, and with strikingly favorable results.   Later on, as physicians became separated more and more from surgeons, the spirit of opposition arose ; the surgeons supported the operation while the physicians condemned it.   And this spirit of antagonism, as Wintrich very justly remarks, may still be distinctly recognized even in the Transactions of the Paris Academy on this subject, of the year 1836.   It was reserved for quite modern times to lay down the indications for operative interference and to settle the methods that should be adopted ; thus it has been more and more perfected, so that now, even in the hands of less expert and less experienced practitioners, the operation is performed with excellent results.

The principal French clinical physicians, in the first place Laënnec, Monneret, Fleury, and then especially Trousseau and Reybard, and later on Sédillot, Marrotte, and Boinet, must be recognized as having led to the wider acceptance and diffusion of the method of puncturing pleuritic effusions.   Also the sharper distinction as to the treatment of pleuritic effusions, according as they are fibrino-serous or purulent, and the conviction that in the former, removal by puncture, with exclusion of air, is indicated, while in the latter it is almost always only the radical operation of incision that leads to a cure, first gained firm footing in France, and found numerous followers, as ap-

pears from the Report of Marrotte (1857) and from the Transactions of the Société Médicale des Hôpitaux in Paris of the year 1864.

In Germany it is only very lately that the treatment of pleuritic effusions by operative measures has found any acceptance, and even at the present time, we may see in the most popular and celebrated manuals of surgery, that direct danger to life from approaching suffocation, and the bursting or the imminent bursting of an empyema outwardly, are the exclusive indications for operative interference. Skoda and Schuh[1] have indeed published a series of cases in which the thorax has been punctured for pleuritic effusions, and at the same time recommended their trough apparatus, and Krause,[2] Riecke,[3] and Wintrich[4] have, in most distinguished works, supported operative treatment; but it is only during the last ten years, through the treatises of Roser,[5] Kussmaul,[6] Bartels,[7] and Quincke,[8] in which additional observations have been continuously reported to show that the radical operation in most purulent effusions is the only really effectual method of cure, that it has found a wider acceptance with German physicians. But even still with this, as with every other surgical procedure, we are in the habit of waiting until life appears endangered or the pus threatens to discharge itself outwardly. For the same reason puncture of sero-fibrinous effusions is but little practised by German physicians, and it is only by a few clinical physicians, as, for example, by Traube,[9] that it has for many years been adopted, in accordance with the same indications as those given by Trousseau, and of which we shall have to speak more in detail presently. Even when Bowditch, of Bos-

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[1] Oesterr. Jahrbücher, 1841, 1842, 1843.

[2] Empyem. Danzig, 1843.

[3] Journal für Chirurgie und Augenheilkunde, 1846.

[4] L. c., 1854.

[5] Zur Operation des Empyems, Arch. f. Heilkunde, 1865.

[6] Deutsches Arch. f. klinische Medicin, IV., p. 1 et seq.

[7] Ditto, p. 263 et seq.

[8] Verhandl. der Berl. medic. Gesellschaft, 1874, p. 17 et seq.

[9] Gesammelte Beiträge, II., p. 1122.—When I first attended Traube's clinique, more than seventeen years ago, puncture of the thorax with a trocar, and with exclusion of air, had already been frequently performed.

ton,[1] introduced into practice the greatest improvement in puncturing pleuritic effusions, viz., the use of capillary trocars and the withdrawal of the fluid by means of an exhausting syringe, this did not incite to more frequent adoption of puncture. Indeed, the new method remained quite ignored among us, because other physicians, such as Scultet,[2] Guérin, Stansky,[3] and Wintrich[4] had tried the method of aspirating the effusions, but had soon laid it aside again, partly from theoretical considerations, partly because they did not attain any decidedly good results in carrying it out. And even when Bowditch in a later contribution[5] reported 150 similar operations, which he had performed on seventy-five persons in this way, and when in France Dieulafoy,[6] in Denmark Rasmussen,[7] and in England soon afterwards Mayne[8] obtained a more general adoption of the method by the construction of ingenious and practical apparatus, and stimulated the zeal of many other physicians to the description and application of very various instruments, yet, strange to say, Bowditch's method only slowly found acceptance in Germany, although, through it, the results of puncture were essentially better and surer. At the session of the Berlin Medical Society, on the 29th of November, 1871, Quincke[9] communicated six cases of exudative pleuritis which he had punctured according to Bowditch's method. In May, 1871, on the recommendation of an American colleague, a friend of mine, who had long been a pupil of Bowditch, I myself first performed the operation of puncture of the chest according to this method, and since then I have undertaken it, or had it performed under my guidance, 164 times in eighty-five different cases. But even in the year 1872 so little was the method of puncture with aspiration valued for

[1] American Journal, April, 1852.

[2] Trousseau, Clin. méd. (p. 669 of Culmann's German translation).

[3] Bardeleben, Lehrbuch der Chirurgie, III., p. 614.

[4] L. c., p. 326.

[5] American Journal, 1863.

[6] Traité de l'aspiration des liquides morbides. Paris, 1873.

[7] Virchow's Jahresbericht, 1870, p. 118.

[8] Dublin Quart. Journal, 1871.

[9] Verhandl. der Berl. medic. Gesellsch., 1874.

its favorable results by German physicians—chiefly, no doubt, because in general only very few of them had collected very considerable experience of this mode of treatment—that Lichtheim,[1] for example, says "the forced discharge of the effusion by the application of exhausting apparatus must be rejected." It is only during the last two years that this method has found warm supporters even among German physicians; but I have had various opportunities of convincing myself that we are not yet, by a long way, in a position to say of our medical men, what Rasmussen says of those in Copenhagen, that every medical practitioner in the city possesses his aspiration-apparatus and uses it in suitable cases.

It appeared to me necessary, in the first place, to give this general account of the history and development of operative procedures in the treatment of pleuritic effusions, before proceeding to the discussion of details.[2] We are chiefly indebted to Trousseau[3] for laying down precise indications as to when operative interference should be had recourse to in the removal of effusions into the pleural cavity. The operation is called for not only when there is danger to life from immediate suffocation, but also generally when the effusion is very large, *i.e.*, when there is absolute dulness over the whole of one side anteriorly, or where there is only a small strip where the dulness is not absolute, and this yields a high-pitched tympanitic note ; for we are taught by experience that in the case of such extensive effusions death may often supervene quite suddenly either from syncope or from acute œdema of the sound lung. Therefore in such cases there should be no delay in operating. Other authors have related circumstances similar to the one which occurred to me in 1867, when, as clinical assistant in the Charité, late in the evening I had a case put into my hands, in which, after close examination, I believed an operation was indicated, and only on

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[1] Ueber die operative Behandlung pleuritischer Exsudate, Volkmann's Sammlung klinischer Vorträge, 1872, p. 168.

[2] It may here be mentioned, in order to complete the history of the operation, that Hippocrates sometimes opened the pleural cavity with a red-hot iron, and that this method has been in later times frequently practised by the Arabian physicians.

[3] Journal de Médec., Nov., 1840, and Bull. de l'Académie de Méd., 15. Avril, 1846.

account of the lateness of the hour I was led to postpone it
until the next morning. During the night the patient hastily
called to the attendant on duty for help, and when the latter
hurried up, the patient was dead. The effusion was, moreover,
on the left side, and as post-mortem examination showed, the
lower part of the vena cava in the neighborhood of the foramen
quadrilaterum was twisted almost at right angles. One such
sad experience is sufficient to induce us never to delay an opera-
tion, even for an hour, when once we are satisfied that it is called
for. And this is all the more obligatory when the patient either
suffers continual dyspnœa or complains of attacks of oppression
coming on from time to time.

Thirdly, removal of the fluid by operation is indicated in
moderately large effusions if absorption is long delayed, for
frequently in these cases the reason why absorption does not set
in is because the pressure which the pleuritic effusion exerts on
the orifices of the lymphatics is too great for any absorption to
be possible, and as soon as this pressure is relieved by the out-
ward discharge of the effusion, the absorption of the remainder
proceeds of itself rapidly and completely. If, moreover, absorp-
tion is delayed, patches of caseous pneumonia are very readily
developed in the compressed lung, to which miliary tubercle is
sometimes added, or very thick pleuritic membranes remain
behind as residua of the effusion, and these forever impede the
re-expansion of the lung, and generally lead to contraction of
the chest. Therefore in such cases, following Trousseau's
advice, we must puncture. We must also puncture when we
are satisfied that the effusion is purulent, no matter whether it is
large or small in amount.

But the operative treatment of purulent effusions is essen-
tially different from that of other inflammatory exudations, and
especially of sero-fibrinous effusions.

In the latter case the evacuation of the fluid by means of a
trocar is all that is necessary. Yet in this case there is always
one impediment to be taken into account. We cannot withdraw
a large quantity of fluid from the pleural cavity by means of
such a puncture, unless the pressure on the fluid from within
the cavity is greater than that of the atmosphere; if, however,

this pressure only just balances that of the atmospheric air, we shall only find a few drops of fluid discharged externally, and that during forced expirations, especially during fits of coughing. This I have observed in some cases in which the quantity of the pleuritic effusion amounted to several litres. The more feeble the expiratory power, the less effusion escapes externally. Sometimes not a drop of fluid is removed. I remember a case of this kind in a man, seventy-five years of age, who was not able to cough at all. There is no means of ascertaining with accuracy, before puncturing, what is the amount of pressure within the pleural sac. It is true that we know by experience that in recent effusions the pressure is generally great, whilst in old ones it is small, and that the displacement of adjacent organs is indicative of great pressure. But all these conclusions are entirely untrustworthy; I have punctured, in recent effusions, with considerable displacement of adjacent organs, and yet found the pressure so slight, that by simple puncture only a very small quantity of fluid could be removed.

The withdrawal of the effusion by suction-power had, as we have stated above, been already advocated in early times, as a means of securing the object we have in view in puncturing without being dependent on the amount of pressure to which the fluid is exposed; but Bowditch was the first to introduce aspiration into practice as a reliable therapeutic resource. The fears which formerly prevailed, on theoretic grounds, that, as a result of aspiration, the lung might be two violently expanded, and in this way laceration of its substance, dangerous hemorrhages, or the development of pulmonary œdema might occur; the experience of Bowditch himself, which has since been confirmed on all sides, has proved to be unfounded. The fear also that in aspiration of the pleuritic effusion the lung might be drawn into the trocar, and the pleura pulmonalis in this way injured, is practically proved to be without foundation, especially if we are careful to use a thin, really capillary trocar. Moreover, in order to try the strength of the aspiration, I have often made the experiment of placing the tube of the trocar on the skin of my hand, and so convinced myself of the slight force with which the suction, on and off, acts. But a special

value of the method of aspiration is just this: that we can use quite capillary trocars for the removal of the effusion. The operation is naturally thus rendered so little formidable that even a possible injury to the lung or diaphragm, such as has happened many times to Bowditch, is attended with only very slight disadvantages. Bowditch has never seen any ill results from it. The assertion that thick, purulent effusions cannot be withdrawn through the capillary tubes, is also an unfounded objection to the method. I have repeatedly aspirated quite thick purulent masses out of the pleural sac through the capillary canula of a trocar.

I regard it as but of little importance what particular apparatus for aspiration we make use of; they are all useful, and one has but very little advantage over another.

Naturally I shall not attempt to criticise minutely all the different modifications of the method of aspiration described and recommended, especially in France, of late years, but I propose rather to confine myself to those in most general use. The most simple arrangement is that which goes by the name of Weiss's stomach-pump, which is used by Bowditch, but under the erroneous name of Wyman's. It is a common syringe with a doubly perforated cock; through one aperture the fluid is sucked into the syringe and through the other, by a quarter turn of the cock, it is discharged externally. The same result is, of course, obtained by a syringe with two cocks, one of which is always open while the other is shut, an instrument which for years has been in use among us for various surgical purposes, and which Quineke has also used for puncturing the chest. The canula of the trocar must not be in direct communication with the end of the syringe, but connected to it by means of a pretty strong India-rubber tube of moderate length. In this way all those movements of the syringe, which, with the greatest care, cannot be avoided, will not be communicated to the canula so as to give pain to the patient. A similar elastic tube is attached to the discharging aperture, so that the fluid withdrawn is conveyed into some convenient vessel at hand, and prevented from wetting the patient.

For a medical man who cannot afford to spend much in instruments, such a syringe, with a double cock, or a doubly perforated cock, will suffice for the aspiration of pleuritic effusions. The syringe devised by Dieulafoy is more complicated, in this, while the double-aperture cock is shut, the piston is forcibly pulled out and kept secure in this position by a check, and then the rarefied space is put into communication with the pleural cavity. Here also both apertures of the syringe are provided with India-rubber tubes. This apparatus is very suitable to the purpose, and well constructed; but in my opinion it offers no kind of advantage over the above-mentioned syringes, even though Dieulafoy attaches quite a special importance to the production of a rarefied space before the discharge of the fluid. The rarefied

space is much too small to justify this claim.   On the other hand, the aspiration apparatus designed, much at the same time, by Potain and Castiaux, in Paris, and by Rasmussen, in Copenhagen, and which differ only in trifling details from one another, in which a large glass bottle is in direct communication with a small air-pump, has been very much approved.   By this arrangement the air in the bottle can be more or less rarefied, and the rarefied space thus produced, by means of a long India-rubber tube, provided with the necessary stop-cocks, is placed in communication with the canula, and so with the pleural cavity.   A glass tube inserted into the India-rubber one allows us to see the quality of the effusion and its rapidity of flow, even before it flows into the bottle, and collects at the bottom of it.   If, through the glass tube, we see the outflowing stream evidently slackening, then we must shut off the bottle from the tube by means of a cock placed close to the junction of the tube with the trocar-canula, again exhaust the air in the bottle, and then reconnect it with the tube.

This Potain's, or Rasmussen's bottle, as we are in the habit of calling it, combines the utility of a syringe with two cocks with the advantage that the whole aspiration process can be carried on without the smallest inconvenience to the patient.   If we place the bottle behind the patient's back, and at some distance from his bed, and perform the necessary rarefying process there, the patient, apart from the mere prick of the puncture, often does not know what is being done with him until the evacuation is complete, and he is shown the fluid which has been withdrawn.   It is always advisable to attend to this last point, because when the patient has become conscious, by seeing it, that a great part of the contents of his pleural cavity has been let out, he is very much encouraged and richly compensated for the distress which has been caused him by the idea of having a puncture made into his chest.

Repeatedly, already, in this discussion of methods of aspirating, we have stated that we have placed the apparatus employed in communication with the canula of the trocar, and thus anticipated the decision of the question with what instrument the puncture should be made.   To do this with the point of a knife has long been given up, because the conviction gradually gained ground that the admission of air into the pleural cavity might convert a sero-fibrinous effusion into a purulent or even an ichorous one.   Strange to say, universal as this experience has proved, the opinion that the same injurious influences which extensive admixtures of air exercise on pleuritic effusions may also be produced by a few bubbles of air, has not yet gained universal acceptance among physicians.   The simple fact is, that with the air certain excitants of infection make their way into the pleural cavity.   That this may happen through only a single

bubble of air, every one must at once admit from our present
scientific stand-point with regard to various affections. I there-
fore hold the opinion to be a false one which has been main-
tained even in late years by Lichtheim (l. c.) and Lebert,[1] that
the entrance of a few air bubbles into the pleural sac during the
puncture is harmless. Certainly there are cases in which such
an admission of air does no harm, and I have myself seen such;
but then the air was not charged with infection germs; on the
other hand, in other cases that I have watched, through the
admission of very small quantities of air into the pleural cavity,
simple sero-fibrinous effusions have become in a *foudroyant*
manner converted into purulent or sometimes even into ichorous
ones. This want of care in avoiding the admission of a few bub-
bles of air causes many cases of puncture in pleuritic effusion to
take an unfavorable turn, and interferes with the results of a
method of treatment which in and by itself promises the greatest
success.

Therefore, in order to prevent the entrance of a considerable
amount of air into the pleural cavity, we have for many years
given up the practice of puncturing with a knife, and adopted
the trocar. It is only recently that we have employed, instead
of this, a perforated needle—the so-called "hollow needle"—
especially in conjunction with aspiration. This has been more
particularly made use of in France, on the suggestion of Dieu-
lafoy. Bresgen, some years ago, advocated its adoption in Ger-
many, and more recently, in a modified form, it has been
adopted by Tutschek.[2] In choosing, however, between the hol-
low needle and the trocar, we must unconditionally give the
preference to the latter. For if one is not particularly careful in
the use of a hollow needle, the point of which must necessarily,
in order to be used conveniently, be considerably longer than
the point of the trocar, which projects beyond the canula, and
if one is not an adept at puncturing the thorax, or if one is
induced to follow the advice of certain authors, and for special
reasons to make more extensive excursions in the pleural cavity

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[1] Berl. klin. Wochenschr., 1874.

[2] Die Thoracocentese mittelst Hohlnadelstichs.   München, 1874.

with this hollow needle, serious injury to the lung may very easily be done.

At the time when large and not capillary trocars were used for puncturing the thorax, and no aspiration apparatus was employed, the fluid contents of the pleural cavity were allowed to flow out through the canula as long as it was possible, that is, so long as the pressure to which the effusion was exposed was greater than that of the atmosphere. This pressure might be momentarily increased by fits of coughing. So soon, however, as it was in equilibrium with the atmosphere, or below it, naturally nothing more flowed out, however great the column of fluid within the pleural sac might be. Corresponding with the fluctuations of pressure within the thorax, during inspiration and expiration, it would often happen, either from the commencement or very soon after the effusion had begun to flow out, that only during expiration was the internal pressure greater than that of the atmosphere, whilst during inspiration it was, on the contrary, less. It then would follow that fluid flowed out only during expiration, and during inspiration air would actually be drawn into the pleural sac ; in this way not only was a pneumothorax produced, but as, with the air, parasitical or other irritant matters gained admission to the pleural cavity, the pleuritis might thus become purulent or ichorous. It was from such observations as these that people first began to consider what means might be devised for preventing the entrance of air into the pleura during inspiration. To meet this difficulty, Schuh-Skoda's trough apparatus came into use, but as it was not convenient to handle, it gained but little acceptance. Biermer had the external end of the tube bent somewhat downwards and placed in a medicine bottle filled with tepid water. This, besides being, in the first place, inconvenient, is, in the second place, dangerous in itself, since during inspiration, when the pressure in the pleural cavity becomes less than that of the atmosphere, water may be drawn into the pleura. Reybard's advice, on the other hand, was very soon widely diffused ; he recommends that a piece of catgut or goldbeater's-skin should be fastened to the canula of the trocar. By this means, while no impediment will be opposed to the outflow of the effusion, at the moment

when the pressure within the thorax becomes less than that out-
side it, and the air presses towards the canula, the goldbeater's-
skin will then be driven into it and act as a perfectly secure
air-valve, and so prevent all entrance of air. With some pre-
caution this method never fails one. At least I made use of it
in every case of puncture of the thorax, up to the year 1871, and
never saw any air gain access to the pleural sac.

Since we have employed aspiration, such a plan as the above
is naturally out of the question; on the other hand, since we
can through aspiration produce rarefied spaces in a far more
energetic manner than by simple outflow of the effusion, unless
the whole apparatus is made to close hermetically, air out of
the neighborhood rapidly presses into these spaces and may
probably convey infective particles into them. In the aspira-
tion method it is therefore of the first importance to provide the
canula of the capillary trocar with a hermetically closing cock,
because the atmospheric air in the tube connecting the canula
with the syringe or flask is only too apt to make a reverse move-
ment into the pleural cavity, especially when a large quantity
of fluid has been discharged. If the canula is provided with a
cock, then the worst that can happen is that a minimum of air
may enter just at the moment when the stylet of the trocar is
drawn back behind the cock, in order that the latter may be
immediately closed, since such a trocar never moves absolutely
air-tight in the canula. But even this minimum of air may, as
we have explained above, be associated with the greatest danger
to the patient, therefore a really good trocar should secure us
against such a possibility.

The danger of entrance of air into the pleural sac is still
greater if, during aspiration, the canula should become blocked,
and again made permeable. This obstruction occurs with com-
parative frequency since capillary trocars have been in use,
because it is exceedingly easy for a small piece of fibrine, and
other like substance to be arrested in the narrow tube. Most
authors who have frequently performed paracentesis by means
of capillary trocars and aspiration, mention the occurrence of
these unpleasant obstacles in carrying out the process, and sug-
gest various remedies for overcoming them.

Bowditch, Dieulafoy, and Tutschek advise that, after we have allowed the air-bubbles that may possibly be present in the syringe to escape, we should syringe back a part of the extracted fluid towards the pleural cavity, and in this way drive the obstructing plug out of the tube. But in this case, while on the one hand one runs the risk of infecting the pleural sac, on the other hand, often a very considerable pressure, which for evident reasons must not be too much increased, will not succeed in making the tube again permeable. Bowditch has often found this to be the case, and he therefore advises in such cases that another puncture should at once be made in the neighborhood of the first; as this would naturally be very disagreeable to the patient, it is on that account not very advisable. If, in order to make the tube again permeable, we pass the stylet of the trocar, or a thin, blunt, metal needle again along the tube, here also the simultaneous entrance of a small quantity of air into the pleural sac cannot be avoided.

In order that the canula may be at any moment again rendered permeable, without the reintroduction of the trocar, and without the necessity of again syringing back into the pleural sac the already aspired fluid, the trocar must be constructed with a lateral tube, so that the stylet in the canula will be drawn back only so far as to clear the aperture of this lateral tube, and may at any moment be thrust forward again, and thus the fluid flows away by the lateral aperture.

I have been led by these considerations to have a trocar constructed according to my own designs, and which I have described in the Berliner klinische Wochenschrift.[1] It answers completely to all the requirements to be looked for in a serviceable trocar, as explained above. It is capillary and applicable to any of the methods of aspiration, it closes absolutely airtight, and it allows any obstruction of the canula to be safely removed, in the simplest manner, without the possibility of any entrance of air, and without the smallest inconvenience to the patient; moreover, the instrument is easily cleansed without the aid of an instrument-maker.

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[1] *Fraentzel*, Ein neuer Troicart zur Entleerung pleuritischer exudate. Berl. klin. Wochenschr, 1874, 12.

I have now had paracentesis performed 106 times in forty-seven different cases with this instrument, and I have always found it stand the test.

Many also of my colleagues who have used it have been very well satisfied with its working.

For the sake of completing the account of the operative procedures, I shall give a detailed description of the apparatus ; but a clearer idea of it will be gained by reference to the drawing given in the Klin. Wochenschrift (l. c.).[1]

The anterior part of the canula of this trocar consists of a capillary tube five centimetres in length, and at this point, in order to add to its firmness, its walls increase in thickness, while the diameter of the lumen remains unaltered ; and here the canula gives off, at an angle of 45°, a short, lateral tube, with a canal of the same width, which can be shut off by an air-tight cock. Close on the other side of the cock this lateral pipe ends in a short metal tube, into which is fitted air-tight the metal end-piece of the India-rubber pipe, which forms the beginning of the aspiration apparatus. About half a centimetre beyond the connection of the lateral tube the canula ends in a screw, which is closely fitted into a " worm " that forms the summit of a hollow cylinder notched at the side. By means of this screw the latter is firmly connected with the canula, and so really forms simply a continuation of it ; beneath the screw there is also a small space, intended for the reception of small India-rubber plates. The hollow which forms the " worm " of the screw is closed below by a plate, having a small perforation in its centre, through which the stylet of the trocar passes. The whole of this screw apparatus forms the upper lid of the hollow cylinder, the lower being formed by a large button, which can be unscrewed, and thus the cleansing of the whole hollow cylinder be effected. Through the capillary canula described above moves the fine stylet of a trocar, fitting in as tightly as possible, and this extends downwards through the screw combination, and there ends in a knob. In the side of this knob a button is screwed which, when it is pushed back as far as possible along the side-notch, draws back the whole stylet till it comes behind the point of connection of the lateral tube. If the capillary canula becomes obstructed, the obstruction is overcome by simply pushing forward the stylet by the button ; and if we wish to prevent the sharp point of the stylet from projecting beyond the canula, we can measure exactly by the position of the button when the point of the stylet has reached the extreme end of the

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[1] An instrument similar to my trocar had already been introduced in the year 1858, in the Medical Times and Gaz., by Dr. Charles Thompson, of Westerham, and recommended by Spencer Wells for puncturing in ovariotomy. But Thompson's trocar naturally does not answer to our present wants. It is not capillary, it does not close hermetically, nor is it adapted to simultaneous aspiration. After the publication of my paper in the Klin. Wochenschrift, I learnt that Potain (Peter, l. c., 637) had also constructed a similar trocar, over which, however, mine has the advantage of the India-rubber plates and the cock at the lateral tube.

canula. The presence of three small thin plates of India-rubber, pressed in between the screw and the screw cylinder, by which the stylet is shut in absolutely air-tight, enables us to move the stylet of the trocar backwards and forwards, without the admission of any air from without into the pleural cavity. After every time of using, the India-rubber plates are taken out, and replaced by new ones. They may be cut out of any piece of India-rubber tubing you please. The taking to pieces and cleaning the apparatus are just as easy.

Before we describe the mode of making the puncture itself, two questions have to be considered : when should we operate, and where?

The first question is partly answered already by what has preceded, as is evident. If there is danger to life, or if the effusion is very considerable, and this is accompanied by dyspnœa, we must puncture at once ; but even if there is no dyspnœa, we ought not to hesitate in the case of very large effusions. On the other hand, if there is but little displacement of adjacent organs, and not much more than a medium amount of effusion, in that case it will be desirable to delay the operation until the height of the inflammation is over.[1] Generally, therefore, it is better not to puncture before the end of the third week. If, in such cases, it is done earlier, it often happens that the fever is increased still more ; at any rate, the effusion constantly returns again to its former level after the puncture. If, on the other hand, the pleuritis is attended with but moderate fever and little pain, the operation may be ventured on sooner, even before the end of the second week, and will conduce to a favorable recovery. If the symptoms justify the supposition that the effusion is purulent, then the diagnosis can only be made absolutely certain by puncture, which must not, therefore, be long delayed.

Much discussion has arisen as to the place where the puncture ought to be made. In my opinion it is best to follow Laënnec's advice and puncture between the mammary and the axillary lines, tolerably near the former, and just above the sixth rib. If we choose a lower position in the anterior chest wall, we may easily injure the diaphragm or the abdominal organs, as has happened to Laënnec. For this reason I am in the habit of

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[1] *Traube*, Gesammelte Beiträge, II., 1122.

selecting the fifth interspace on the left, and the fourth inter-
space on the right side, in order to keep clear of the liver.   To
puncture at the posterior wall of the chest as low down as pos-
sible, viz., between the ninth and eleventh ribs, as recommended
by Bowditch, is, according to my experience, unadvisable.   In
the first place, it will sometimes be impossible, in this situation,
to avoid wounding the diaphragm ; and in the second place, the
muscles on the posterior surface of the thorax are sometimes so
thick and tense that they interfere with the accurate discovery
of the position of the intercostal spaces, and with the subsequent
free movements of the canula in the pleural cavity.   In the third
place, moreover, it happens not seldom in punctures in this
situation that although the trocar or canula moves freely in the
pleural sac, yet, on aspiration, not a drop of fluid is withdrawn.

It is evident that in this case the trocar has punctured, at the
same time, a thick layer of fibrine, for if we repeat the punctures
higher up, large quantities of effusion are let out.   The fibrinous
strata of the exudation, simply by their own weight, will natur-
ally, in the recumbent position of the patient, accumulate espe-
cially on the posterior wall of the chest, and when we puncture
there, they will often be met with and may render the operation
of no effect.

The best position the patient can assume for puncturing is
the semi-recumbent one; the objection to his sitting up is that a
sensitive patient may easily faint in that position.

It is not necessary to give chloroform, or to apply local
anæsthetics, as the operation is a very slight one.   It is equally
unnecessary to make a preliminary incision through the skin, as
Trousseau has recommended, if the trocar is a good one.   We
need not nowadays even anticipate a displacement of the skin,
if only capillary instruments are used, as the wound is quite
insignificant.

After having accurately marked the point of puncture in the
previously selected intercostal space, and in doing so, carefully
avoided, as much as possible, the lower margin of the upper rib,
the trocar above described, previously rubbed with freshly
boiled oil, is inserted into the pleural sac at the selected spot,
the stylet being completely pushed forward beyond the canula,

and the cock of the lateral tube closed. In inserting the trocar, the thumb of the right hand is pressed against the lateral button, and so the stepping back of the stylet is prevented, while the first and middle fingers are stretched out along the canula, keeping the cock exactly between them, and the lower button of the instrument rests in the palm of the hand. The trocar is thus thrust in vigorously to the contemplated depth; by slow pressure we might perhaps separate the costal pleura from its attachments and push it in front of the instrument. We then immediately draw back the stylet as far as it will go, and see if the canula is freely movable in the pleural sac; if the walls of the thorax are not completely bored through, we thrust in the stylet once more; then, if we are sure that the canula is in the pleural cavity, we fix the aspiration apparatus, air-tight, to the lateral tube and withdraw the air that is present in the communication-pipe; in this way we immediately ascertain whether the whole aspiration apparatus closes hermetically; we then open the cock of the lateral tube and aspire the fluid out of the pleural sac.

In doing this we must remember carefully, each time, to close the cock of the lateral tube before we let out the contents of the aspirating syringe, in order to prevent any retrograde movement of air or fluid in the communicating-piece between the trocar and the aspirator. If we employ the Potain or Ras·mussen flask for aspirating, the whole process is more simple.

If we find, during aspiration, that the discharge of the fluid is arrested, and if, on examination, we find that the canula is still below the level of the column of fluid in the pleural cavity, then, in all probability, the canula is stopped up. In that case, we shut the cock of the lateral tube, push forward the stylet for a moment, and then, on drawing it back again, aspiration proceeds successfully as before through the lateral tube. When we have removed the quantity of fluid we intended, and for reasons to be hereafter given, I do not advise more than 1,500 cubic centimetres to be removed at once, then we again shut the cock of the canula, again remove the aspiration apparatus, and slowly withdraw the canula from the intercostal space, place a finger of the left hand on the wound, and then, immediately, a little cross

of sticking-plaster, and this may be secured with a few more strips of plaster and some collodion. Thus the whole operation is completed. Even in withdrawing the canula, the entrance of air into the pleural sac is impossible.

Various circumstances may arise during and after the operation for which the physician should be prepared, in order that he may not be taken by surprise when they appear, or even compelled to desist from the operation. In the latter case, not only does the physician lose credit in the eyes of his patient, but the patient generally is henceforward afraid to submit anew to the operation, much to his own disadvantage.

In the first place, we should always satisfy ourselves, before beginning the operation, that our apparatus is in good working order, and that it closes perfectly air-tight. I cannot urge this advice too strongly, since many times I have myself, too confidingly, left the examination of the apparatus to my assistants, who were well versed in the operation, and by so doing I have found myself in very awkward positions ; on one occasion I was even compelled to put off the operation to the next day, because the necessary apparatus was defective. We should never neglect, immediately before puncturing, either ourselves to disinfect the whole apparatus, or at least to see this done under our superintendence. Only the most earnest care on the part of the physician in this particular can protect the patient from serious ill effects. It is also important, each time before using the trocar, to see that the canula fits quite close to the stylet at its anterior extremity, and that its edges are here finely bevelled off. Trocars are often very defectively finished in this respect. and then these are, from the first, more or less unserviceable, or they soon become so from the fact that the material of which the canulæ are made by our instrument-makers (generally new silver) is too soft, and therefore, after repeated use, the orifice of the canula widens. Such a canula, not closing tightly round the stylet, catches, with its anterior extremity, against the skin. and either causes the introduction of the trocar into the pleural cavity to be only possible with great suffering to the patient, or absolutely prevents its penetrating further, even with the exertion of the greatest force. In such a case, the resistance

offered by the skin is sometimes so considerable that if the trocar is pushed forward with some energy, it will actually bend in the hand of the operator. If there is any difficulty in forcing forward the instrument, it is best to make a little incision in the skin, as Trousseau has recommended in all cases ; after the resistance of the skin is overcome, generally the inter-costal muscles and the pleura costalis offer no considerable hin-drance, even with a badly constructed trocar, having a yielding canula. The most practical method of testing a trocar, with respect to the possible resistance of the canula, is to thrust it through a piece of sticking-plaster. If it passes through this without resistance, it will also go smoothly through the skin.

If we could make the canulæ of capillary trocars, as we do those of stronger instruments, somewhat springy by means of a slit at the side, or use a harder material for their fabrication, a remedy would be provided for the drawbacks just mentioned, which we can now escape only by careful preliminary trial of the trocar. But all the instrument-makers declare that it is impossible to make these capillary canulæ springy, or to manu-facture them out of harder metal.

Another unpleasant incident which may sometimes happen to the most skilful operator, in the case of very sensitive patients who change their position considerably the moment the trocar is inserted, is that he may strike against a rib instead of entering the intercostal space. If one is prepared for this possi-bility, and skilled in performing the operation, a slight turn of the hand is sufficient to divert the trocar from the rib, and make it pass into the intercostal space selected. Should it happen that the patient faints at the moment the trocar pierces the chest, or during the withdrawal of the effusion, a circumstance which occurs very rarely, then let the instrument lie quietly, with the stylet drawn back, bring the patient round with some stimulant, and afterwards resume the operation.

I have never seen the intercostal arteries wounded during paracentesis, and with the use of capillary trocars I think it is scarcely possible for such an accident to happen.

It occasionally arises that after paracentesis, and when the canula can be felt to be freely movable in the pleural cavity,

that not a drop of the effusion can be drawn off by aspiration, even after one has repeatedly pushed forward the trocar so as to be sure that there is no obstruction in the canula. In such a case it is probable, nay, almost certain, that some coagulated fibrine is lying close to the wall of the thorax, into which the trocar has penetrated. This seldom occurs at the anterior wall of the chest, whereas it is not an uncommon event at the posterior wall. In such a case, one is naturally obliged to withdraw the canula and repeat the puncture in another spot.

Before the method of aspirating pleuritic effusions had been employed, it was often observed, that during the outflow of the effusion, and sometimes not until it was ended, fits of coughing frequently came on, which often required an opiate to subdue them—the best being a subcutaneous injection of morphine. The only way of accounting for these fits of coughing was, that by the discharge of the effusion the lung was rather quickly rendered again permeable to air, and the renewed contact of air with the bronchial tubes set up cough irritation afresh. Since I have employed the method of aspiration, and by its means emptied the pleural cavity very slowly, I have only observed these violent attacks of cough in two or three cases, whereas formerly they were almost characteristic of puncture of the chest.

The hypothesis put forward in some quarters, that these fits of coughing were excited by the canula touching the pleura pulmonalis, is quite erroneous, for I have formerly seen the most violent paroxysms of cough come on, while the quantity of fluid in the pleural cavity was so great that the pleura pulmonalis and the canula could not touch one another; while, on the other hand, I have quite recently, after the employment of aspiration, been able several times to feel distinctly the friction of the canula against the roughened pulmonary pleura without any cough following.

If we take great care that the aspiration proceeds slowly, and that, at most, not more than 1,500 cubic centimetres of fluid are withdrawn at one sitting, then we shall be pretty certain to avoid another unpleasant incident, which is liable to follow puncture, and which we have already more fully spoken of, viz.,

œdema of the hitherto compressed lung.[1] But on other grounds also it is advisable that the evacuation of the fluid should be gradual and the quantity removed limited. For the vessels in the inflamed pleura are, precisely on account of the inflammation, abnormally distended, and in consequence of certain changes in their walls, not yet fully explained in detail (Cohnheim), are especially prone to permit the emigration of lymph corpuscles. If we now, suddenly and very considerably, reduce the pressure which has hitherto rested on these vessels, there is great danger of a large extravasation of serum and lymph corpuscles ; in other words, after a rapid evacuation of a very large quantity of fluid, not only may the effusion very quickly increase in volume, but it may also become purulent. These more delicate anatomical conditions are, in my opinion, not sufficiently thought of, as well in the operation itself as in the after-treatment. Finally, let me mention here one more accident which I once saw set in eight hours after paracentesis, and which is not more fully described in the literature of this subject, that is, a fatal hemorrhage from the lungs.

It was in the case of a phthisical patient, twenty-three years of age, with large cavities in the left lung, and tolerably extensive caseous infiltrations in the right, who, already in a state of the greatest exhaustion, was attacked with left-sided pleuritis. After a course of only eight days this pleuritis had to be pronounced purulent, on account of the enormously high fever (104.1° F.), the intense pain in the chest, and a slight œdema of the affected side of the thorax ; but, in spite of the rapid increase of the effusion, an operation had to be avoided, in consideration of the simultaneous affection of the lungs. After fifteen days' continuance of the pleuritis, the imminent danger of suffocation compelled me to puncture the chest, and by the operation 1,420 cubic centimetres of moderately thick pus were removed. The patient felt himself very much relieved after the operation ; eight hours later he was attacked by a profuse hæmoptysis (about 1¼ litres = 44 oz.) from which he died before the physician who had been sent for could reach the ward. When, on my visit the next morning, I was informed of the nature of the death, I immediately suspected that in this case there had been an aneurism situated in the walls of one of the cavities in the lung, and that this, in consequence of the great rush of blood which, after puncture, took place into the hitherto compressed lung, had burst, and so led to death by hæmoptysis.

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[1] It is difficult for any physician to imagine that aspiration can ever be conducted so violently as to cause laceration of the lung tissue. As I have no knowledge of any reliable observation on this subject, I mention this casualty only as a theoretical one.

I was supported in this hypothesis by the general experience that in hemorrhages which prove rapidly fatal, coming on in phthisical patients in whom cavities are known to exist, the source of the hemorrhage is constantly to be found in the rupture of an aneurism situated in the wall of one of the cavities. Indeed, in the post-mortem examination in the case just described, it was found that an aneurism, about the size of a cherry, in the wall of a cavity, had burst, and had been the cause of the hemorrhage. Certainly a rare and remarkable event!

This observation and two others, in which, notwithstanding the most careful disinfection of the trocar, carried out by myself, and the greatest caution in the performance of the operation, the effusion became purulent, have now induced me, whenever I puncture, not only to keep the patient quiet in bed and on low diet, but also, as Traube[1] advises, to apply to the place of puncture, twice in twenty-four hours, an India-rubber bag containing pounded ice, entirely without reference as to whether the patient suffers pain or not after the operation. Thus we must endeavor to cause contraction of the walls of the vessels distended by inflammation and inclined, after the removal of the pressure caused by the pleuritic effusion, to allow of emigration of lymph corpuscles and greater effusion. How very necessary this antiphlogistic treatment is, is best illustrated by the fact that very often, after puncturing, patients without fever become feverish for a day or two, and in feverish cases a moderate rise of temperature takes place, while even the effusion sometimes increases not inconsiderably. But, as a rule, the increase of the effusion comes to a stand-still, and in simple pleuritis absorption very quickly sets in.

That the value of this method of treatment should have been called in question lately in certain quarters, is wholly due to want of caution, levity, and even also, in some cases, ignorance of the details of the process, as I have described them, in removing the effusion, as well as the defective after-treatment ; whereas this method in its present advanced state evidently belongs to the greatest of therapeutic resources. When Behier and Peter state that in the last six years the mortality from pleuritis in the Paris hospitals has doubled, and seem disposed to attribute this result to the extension of the operative mode of treatment ; in

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[1] L. c., II., p. 1123.

the first place, we cannot admit, without further proof, that the increased mortality is the result of this treatment; and in the second place, we must inquire how many physicians perform the operation, and with what precautionary measures. It may be inferred from various French publications that sufficient attention is not paid to this latter point. And in my opinion it is precisely upon this point that chief weight must be laid, for the more delicate our therapeutic methods become, and the better the results that we may obtain from them, the more minute is the care necessary in carrying them out in order really to obtain these results.

In order to show what results I have obtained by the method I have just described, I need only call attention to the cases of paracentesis which I have performed, or the performance of which I have superintended, with my own trocar, abstaining from all mention of the great number of observations in which I have performed aspiration, but with a common capillary trocar, or with a trocar furnished with a tap. Of forty-seven cases sixteen were cases of primary pleuritis with sero-fibrinous effusion, in which I performed paracentesis twenty-two times, viz., in eleven cases once, in four cases twice, and in one case three times. In the latter, on puncturing for the third time, the effusion was found to be hemorrhagic; the patient, who was over seventy years of age, finally died of exhaustion. The autopsy exhibited a recent tuberculous eruption in the diseased pleura, which had evidently originated in the course of the pleuritis. All the other cases ended in recovery. One patient, who was operated upon on the fifteenth day of the illness, on the twenty-sixth was discharged cured; another patient was punctured for the first time on the thirty-fourth day of the illness, and a second time on the forty-seventh day, and on the seventy-fifth day was discharged cured. These were the extreme limits; in the other cases the day of operation and of dismissal lay between them. In eight cases, also of secondary pleuritis, cure of the pleuritic effusion followed puncture, and in one case after puncture had twice been performed, in spite of the existence of caseous pneumonia.

After paracentesis there is generally a feeling of heat and

smarting at the seat of puncture, and an indefinite sense of pressure on the affected side of the chest. The smarting usually disappears in a few hours, and in the worst cases does not last more than a day or two.

It is only when the effusion becomes purulent that violent pains, accompanied with high fever, not infrequently supervene. As we have already observed, there is usually a slight rise of temperature noted for a day or two, which the effusion increases somewhat. On the second, third, or fourth day this increase ceases, and absorption commences somewhat rapidly, and is attended by a greatly augmented flow of urine. Slight cutaneous stimulation, and especially painting with iodine, together with the internal administration of decoction of cinchona and acetate of potash, tend considerably to promote absorption. If there was a very large amount of effusion, absorption proceeds but slowly until puncture has been a second time performed. Then, as a rule, the remainder of the effusion disappears pretty rapidly, leaving only a small quantity unabsorbed. As in the case of pleuritic effusions which do not call for operation, this residuum will be absorbed very slowly, often not for months, but most rapidly, as we have already said, if the patients select a high mountain residence for a considerable time. If the pleuritic effusion rises continuously after paracentesis, and is attended with high fever, there is strong reason to suspect, apart from the other symptoms, that the effusion is hemorrhagic or purulent.

If the first puncture has shown the effusion to be hemorrhagic, then, according to all probability, a tuberculous pleuritis exists. Nevertheless, if the fluid rises again rapidly, we must attempt a second, or even a third operation, for even in tuberculous pleuritis we must not exclude the possibility of an incomplete cure, *i.e.*, an entire disappearance of the fluid effusion, and, moreover, we must not conclude that every hemorrhagic effusion is the result of tuberculous inflammation. If, however, the effusion, even after the second or third puncture, attains in a few days its former height, and possibly exceeds it, then the operation must not be repeated, since it will, probably, only lead to the sudden exhaustion of the patient. If, after paracen-

tesis, the hemorrhagic effusion undergoes purulent changes, then, naturally, it must be treated as a purulent one.

Of the symptoms and the various results of the latter we have already spoken. We can scarcely prove by direct observation, that a purulent effusion may result in simple recovery, as the diagnosis is always open to dispute. Since pus corpuscles undergo fatty metamorphosis and become absorbed, theoretically the possibility of the complete absorption of slight purulent effusions must be granted. Some authors put forward autopsies which they have made on persons who have died accidentally, and who were certainly free from fever before their death, and in whom smaller or larger encapsulated purulent exudations were found, as proof of the assertions that such exudations are capable of absorption. These observations are very rare, but doubtlessly accurate. I have myself seen two cases in which an encapsulated purulent effusion had existed for more than a year without any feverish symptoms, and was only discovered at the autopsy, the patients having died from other causes. In these cases I believe the absence of fever was due to the circumstance that the purulent masses were surrounded by very thick non-vascular membranes, which made it impossible that the constituent parts of the pus could reach the circulation and act as excitants of fever. Such cases, however, do not prove that purulent effusions are capable of absorption, for there are also non-encapsulated purulent effusions which for whole months neither increase nor diminish, and, evidently for the same reason as when the pus is encapsulated, run their course quite without fever, but eventually terminate fatally. I have seen several such cases, but I have never been able to convince myself of any kind of absorption.

Another process by which a purulent effusion may result in recovery has also been already mentioned, viz., where by necrosis of a small portion of the pulmonary pleura the pus infiltrates the lung tissue, and so reaching the bronchi is gradually discharged, but it is only rarely that recovery takes place in this way, and then after a tedious illness; much more commonly the lung tissue becomes seriously diseased at the same time. If, however, the purulent contents of the pleura break directly into

a bronchus, or externally through the pleura costalis, a fatal termination may generally be looked for, often after years of failing health ; if the contents do not escape outwardly, the patient usually sinks in consequence of exhausting purulent fever.

It is on account of these sad experiences, taken in connection with the fact that puncture in purulent effusions but very rarely leads to recovery, that what is called the "radical operation," that is, the withdrawal of the pus by means of an incision into the pleural sac, has come more and more into favor, and it has frequently been attended with favorable results.

The general adoption of this mode of treatment has been greatly promoted in Germany by the valuable works of those two eminent clinical physicians, Kussmaul and Bartels, and since, in late years, the rapid improvement which has taken place in the surgical treatment of wounds has been utilized in the management of purulent pleuritic effusions, this plan of dealing with such cases has become more popular, and its results more certain.

The diagnosis of a purulent exudation is rendered probable when, as we have clearly said, such symptoms as high fever, intense pain, and œdema of the affected side of the chest are present, but it can only be rendered certain when, after puncture with our trocar, pus has been drawn into the aspirator. It is rash, without such an exploratory puncture, to conclude that the diagnosis is established, or, as has happened in France, to proceed to the radical operation, and then, after incision, to find that a sero-fibrinous fluid only has escaped. Naturally, by such a proceeding, nothing but serious disadvantage can occur to the patient, especially as the radical operation is not indicated in every individual case of purulent effusion. If, however, we are once convinced of the probability of the existence of a purulent pleuritis, we must no longer lose time with other measures, for it will often happen, quite suddenly, that the pus will force its way into the bronchi and induce suffocation ; or if this does not happen, a pyopneumothorax is frequently developed, in which case the chances of the radical operation become much less favorable than when the pleura is uninjured. The same holds good with regard to *empyema necessitatis*.

When we suspect a purulent effusion, we must, in the first place, puncture, and in the same cautious manner as we should adopt were the effusion sero-fibrinous, we should withdraw, at most, 1,500 cubic centimetres of pus; then we should remove the canula, close the wound with adhesive plaster, and pursue precisely the same antiphlogistic after-treatment. Sometimes complete recovery follows a single puncture, sometimes two or three are necessary to bring about this result. On the whole, therefore, it is always better to try the effect of two or three punctures before proceeding to the radical operation, although the cure of purulent effusions by means of such punctures is a very rare event. The more rapidly the effusion reaccumulates after puncturing, the less chance is there of bringing about a cure in this way. Still, however, it is possible that by repeated puncture the pleural surfaces which come in contact, after the removal of the fluid, may partially cohere, so that when we are compelled subsequently to have recourse to the radical operation, there may be a less extensive suppurating surface of pleural membrane.

If, after puncturing, the pus in the pleural cavity quickly re-collects, or if the fever runs very high, or if there is fear of exhaustion, we should, without delay, make an incision into the pleural cavity. For this purpose the patient should be raised somewhat—avoiding, however, any great pressure on the sound side, so as not to compress the healthy lung and induce a violent attack of dyspnœa—and then chloroform should be carefully administered.

The incision should be made in the fourth or fifth intercostal space, midway between two ribs, and parallel to them, unless a pre-existing thoracic fistula, or a very considerable narrowing of one or other intercostal space, in consequence of the duration of the illness, compels us to choose another place for the incision. The incision, from six to seven centimetres in length, should be commenced somewhat external to the mammary line and carried towards the axilla. After division of the skin, an assistant should separate the muscular layers by means of two hooked forceps, and if the muscular structures are very strong, the margins of the wound must be kept open by means of broad,

blunt hooks, while all bleeding arteries must be carefully ligatured.   When the pleura costalis is thus freely laid bare, and is
seen as a grayish-white membrane, the point of a knife is introduced into it, and then, with a Pott's knife, the incision is
immediately widened and carried forwards and backwards to
the whole extent of the external wound.   In opening the pleura
we must bear in mind that sometimes it may be itself thickened
to the extent of over a centimetre.   All through the operation,
and also during the dressing of the wound, a spray of carbolic
acid (one per cent. solution), by means of a Lister's apparatus,
should be kept constantly directed on the wound and the surrounding parts.   As soon as this wide opening is made into the
pleural sac, the purulent contents rush out, more or less mingled
with larger and smaller shreds of fibrine.   In order, however, to
avoid the serious disadvantages to the patient which might
result from a too sudden outflow, we should immediately introduce two or three fingers into the wound, so that the discharge
may take place very gradually, while the patient recovers from
the influence of the chloroform and is revived with some wine.
As soon as the effusion is, so far as possible, cleared out of the
pleural sac, we must proceed to cleanse this cavity, and this we
can do by introducing two Nélaton's catheters, having several
openings at their lower ends, as deeply as possible into the
pleural cavity, in the direction of the spine, and then through
one of these catheters allow pure distilled water of a temperature of 100° to 103° F., out of an irrigator, to run in till the
pleural sac is full ; then withdraw this fluid again through the
other catheter, by means of a double-cock exhausting syringe,
and repeat this cleansing process until the water withdrawn
from the pleural cavity is quite pure.   Four or five cleansings,
immediately after the operation, will generally suffice for this.
In the meantime shreds of fibrine, small or large, sometimes the
length of one's hand, thickly infiltrated with pus corpuscles,
having been washed out of the dependent parts of the pleural
cavity, make their way into the wound and are to be carefully
removed.   If possible, leave no fluid whatever behind in the
pleural cavity.   The wound is then to be dealt with in the
following manner : We place in the wound a silver canula,

which can pass easily between the two ribs, but which is
wide enough in the other direction to allow two of Nélaton's
catheters of medium size to pass through it. The canula should
be sufficiently long to allow its free extremity to reach a little
beyond the level of the pleura costalis in the cavity of the
chest. The canula rests on the outer wall of the chest, firmly
soldered into a circular silver plate, which is made so as to lie
evenly on the chest wall, and so that it can be closed by a small
movable lid. This canula, provided with an obturator, must
be introduced, and must fit the patient accurately ; at first, until
such an instrument can be prepared, a provisional one of similar
construction will suffice, even though it does not fit quite closely
to the patient's body.

Directly over the wound, under the canula, a piece of *Lis-*
ter's protective is placed, and the plate of the canula is fastened
to the wall of the chest by means of crossed strips of plaster ;
then the canula is closed by pushing forward the little silver lid,
and this also is covered with a piece of *protective ;* the whole
wound is then covered with a large compress of carbolized gauze,
eight times folded, and a suitable bandage attaches the whole to
the wall of the chest. On the region of the wound, under or over
the bandage, according to the strength of the patient, we place
an India-rubber bag filled with pounded ice, insist on absolute
rest, and administer easily digested animal food and a moderate
quantity of wine.

The dressing must be renewed twice every twenty-four hours,
in the following manner: using the spray all the time we remove
the old dressing, and leave only the silver canula lying in the
wound. Through this we introduce two of Nélaton's catheters,
and, in the first place, allow distilled water, of the temperature
above stated, to run through one of them into the pleural sac,
and when the cavity is quite filled we withdraw it again through
the other catheter by means of an exhausting syringe. We re-
peat this process until the water runs out of the pleural cavity
quite pure. Then we remove, for a moment, the silver canula
as well as the catheters, and cleanse it in the most careful man-
ner in boiling water, introduce it again by the aid of an obtu-
rator, and apply the same dressings as at first.

In order to keep Nélaton's catheters serviceable for a long time, they must be cleansed directly after use, first with hot water and then put in a one per cent. solution of carbolic acid till the next time of using. Every time before using them we should notice whether the catheter has not, perchance, become brittle at the anterior extremity. As soon as we remark this, of course we must choose a new one.

We must be careful that the dressing is thus changed twice daily, always under the disinfecting influence of the carbolic acid spray, so long as the patient remains free from fever, and the pus does not become putrid. The fever naturally disappears immediately after the discharge of the pus; if it return in the course of the illness, it points either to imperfect cleansing of the pleural cavity, and the presence of stagnating pus therein, or that the inflammatory process has started up elsewhere, either in the pleura or the lung. In the first case, the contents of the pleural cavity will be putrid, and will require more frequent (even to five times a day) and more thoroughly disinfecting cleansings; in the latter there is generally a fetid condition of the pleural contents, together with other symptoms of disease. But even if the case runs altogether a normal course, and there is no fever, it is advisable, two days after the operation, to remove the ice-bladder from the wound, and to cleanse the pleural cavity for several days with a solution of common salt, two and a half grains to the ounce, instead of distilled water, and, if possible, we should place the patient on the sound side while we are washing out the pleural sac, so that the wound in the thorax may lie highest, and thus the fluid we introduce may reach every part of the pleural walls. Of course while the patient is in this position we must be very careful, if the slightest dyspnœa supervene, to arrest the flow of water from the irrigator into the chest, and we must also be careful that the direction of the inflowing stream is never turned toward the heart, as thereby we might possibly induce syncope.

After a few days, even if there is no fever, and the contents of the pleural sac are not fetid, we should replace the solution of common salt with compound tincture of iodine, diluted with from twenty to fifty times its bulk of water, or we may use a solution

of permanganate of potash (one grain to the ounce), or a solution of carbolic acid (two grains to the ounce).[1]

Under this treatment fewer and fewer flaky or shreddy masses are discharged from the pleural cavity on the dressings, and the wound becomes cleaner and granulates more and more, so that eight or ten days after the operation it is only with a certain force that the canula can be pressed through the granulating wound. At the same time the pleural sac daily admits a somewhat smaller quantity of fluid. If, in the first few days after the operation, we observe that the lung is adherent to a portion of the pleura, we may be pretty sure that the diminution of the pleural cavity will proceed more rapidly than if, by the operation, we had converted the whole extent of the pleura into a suppurating surface. Paying strict attention to the method of dressing the wound we have above detailed, we must continue to cleanse the pleural sac twice a day, and if the diminution of the pleural cavity comes to a stand-still for a few days, it will be as well to change the lotion used in the dressings ; for example, instead of the solution of iodine use a solution of carbolic acid or of permanganate of potash. We must also endeavor, in introducing Nélaton's catheters into the pleura, as it becomes more and more filled with granulations, to get them into the pleural cavity as far as possible, so as to avoid any possible stagnation of pus in its lowest part. We should also be careful that the fluid flows into the pleural cavity under the least possible pressure, and, especially when the space for the introduction of the catheters has become very limited, that, at the same time, air should flow out steadily through the free catheter ; this is important in order that the freshly formed adhesions of the pleural folds may not be torn asunder by an increase of pressure within the pleural cavity. Through any negligence in this respect we may readily undo the healing processes of a week or longer.

The introduction of the canula must not be remitted (and the thicker the granulations the more disagreeable it becomes to the

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[1] Washing out with a solution of common salt will often be sufficient to lead to a perfect cure, as Traube has pointed out in a case which he orally communicated to me.

patient) until the pleural cavity is quite filled with granulations ;
should the inner end of the canula come to strike upon the lung,
we must endeavor, by placing a few layers of gauze between the
plate and the wall of the chest, to prevent its passing so deeply
into the pleural cavity ; but we must not remove the canula
altogether until the catheters can absolutely no longer penetrate
into the pleural cavity.   If this is done just at the right time,
the wound will be completely healed in a few days.   During
the whole course of the treatment, the patient must be made to
lie as straight as possible, to prevent any deviation of the spine,
and he must be well nourished.

When the wound is quite healed, we may find at the upper
part of the affected side of the chest a normally loud percussion
note and pure vesicular breathing, but there still remains at the
lower, and especially the posterior parts, a marked dulness com-
bined with feeble breathing.   It is only by degrees that these
residua disappear, while the patient himself daily gains strength,
and ultimately, especially if during the after-treatment he can
have the advantage of residence in a suitable health-resort, every
trace of the former illness, even to the scar, may disappear.

So far I have described only the therapeutic procedure which
I regard as the most rational, and with which I have obtained
exceedingly good results.

I first became acquainted with the details of the method I have here described
in the beginning of the year 1873, when, in conjunction with Traube and Wilms,
I treated the case of a girl, thirteen years of age, in this way and found it eminently
successful.   It was a case of pneumonia, in the course of which a purulent effusion
was developed in the pleural cavity, and by Traube's advice, I, in the first instance,
punctured with a capillary trocar, and by means of Rasmussen's flask three times
subsequently withdrew the pleural effusion by aspiration.   Wilms then performed
the radical operation.   Traube directed that the after-treatment should be such as
I have sketched above ; it was carried out with the most conscientious care, and
the cure of the patient was complete.

Since the first case which I saw treated in this way in 1873,
I have had the radical operation carried out in eleven patients
with purulent effusions, following the same principles both with
regard to the operation and the after-treatment.   Complete
recovery ensued in five ; a sixth, in whose case the canula had

been removed somewhat too soon, and, on account of his foolish resistance, the strict after-treatment had been interfered with, was dismissed with an incompletely healed thoracic fistula. He was afterwards, for five months, entirely without medical supervision, and at last returned to the Charité with amyloid degeneration of the liver, spleen, and kidneys, and died there a few weeks ago. Four of those who had been operated upon died; one of ichorization of the pleural cavity with severe tubercular pleuritis and circumscribed caseous deposits in both lungs; another, who at the time of the operation was suffering from amyloid degeneration of the kidneys, and had a thoracic fistula, and for whom the radical operation, with resection of a piece of rib, had been performed, died of secondary peritonitis; a third, who had been attacked with purulent pleuritis as he was recovering from a severe form of typhoid, succumbed to an attack of pneumonia in the lower lobe of the uncompressed lung, which had probably arisen in consequence of catching cold during the operation; and finally, the fourth patient, who in the course of a caseous pneumonia had become the victim of pyopneumothorax, and who had not been operated upon till some months later, when the purulent effusion began to increase considerably, sank from dysentery, which set in the day after the operation, and which was at that time endemic in the hospital. An eleventh case was operated upon not quite a fortnight ago, and gives hopes of recovery; this was a case in which an extensive purulent effusion supervened as an attack of pleuropneumonia, and after twice puncturing reaccumulated in a very short time.

I will now adduce, for the purposes of comparison, the therapeutic results obtained by Moutard-Martin, who has performed the radical operation in seventeen cases, but without adopting that particular mode of after-treatment which I have recommended. Five of these died; two of the five sank from exhaustion, one on the thirty-second day, the other on the forty-seventh day after the operation; in neither were any pathological changes in the lungs discoverable on post-mortem examination. Two others died in consequence of caseous inflammation of the lungs which it was not possible to diagnosticate before undertaking the

operation. In these five patients the pleural cavity was subdivided into several sacs by false membranes, and these could not be sufficiently cleared out in the rinsings; in consequence of this the pleural sac ichorized.

Of the remaining twelve cases, two had thoracic fistulæ with pneumothorax at the time when the incision was made; in a third case the pleural cavity was filled with hydatid cysts which had suppurated; the other nine were cases of purulent pleuritis without fistulæ.

In these twelve cases Moutard-Martin considers there was a satisfactory recovery, although he himself allows that five of them were dismissed with thoracic fistulæ. But he does not mention in what state the remaining seven were after the cure, as to configuration of the thorax and capacity of pulmonary expansion; therefore it is doubtful whether one is justified in speaking of them as complete cures, as I can do in the case of my five patients.

It would be out of place here, and it would lead me into a protracted surgical discussion, if I were to describe more in detail and to criticise all the propositions that have been made as to the mode of treatment of purulent effusions. I must confine myself, therefore, in detailing further the minutiæ of the mode of treatment I have already described, to setting forth its advantages over other methods. Any one would certainly give the preference to the new method who has seen, as I have during past years, as many as eighteen cases in which the radical operation for the relief of purulent effusions was performed, with only two recoveries, and one of these after a tedious course of a year and three-quarters, with serious deformity of the whole thorax.

A different mode of treatment to the radical operation here advocated has been recommended from various quarters. In the first place it was suggested that, after puncturing, a canula should be introduced through the puncture into the pleural cavity, and that this should be left there or replaced by a metallic or elastic *canule à double courant*, and by this means the pleural cavity should be cleared out. For this purpose we were to use distilled water or some kind of disinfecting fluid. Woillez has specially recommended this method; but he, and others, have not obtained

any good results. The same may be said of drainage of the pleural cavity, as first advised by Chassaignac, and afterwards also practised by Gosselin. No physician would now carry out drainage in the way it was proposed by Chassaignac. In the third place, it has been recommended to make only a small opening into the pleural cavity, and to attempt to clear it out from outside. The simplest way of effecting this consists in opening the pleural cavity while the patient is sitting in a bath, so that the pus escapes into the water of the bath, and during inspiration water rushes into the pleural cavity and gradually clears it out.

Hoppe-Seyler was the first to think of thoroughly cleansing the opened pleural cavity by aspiration of water or solution of common salt, while he placed the canula of the trocar in connection with an India-rubber tube which led into a vessel containing water or a solution of common salt. This method answered well in the case in which Hoppe tried it.[1] Bardeleben, however, has reported a case which came under his own care, in which a fatal result followed the same treatment.[2] Weber[3] has simplified this method by making the incision of the empyema in a warm bath; but here also the observations reported by Quincke show how dangerous this proceeding is, as death may arise from syncope.

Moreover, Potain, in France, and Roser, and subsequently Vogel and Quincke, in Germany, have proposed a method of treatment for clearing out the pleural cavity by the alternate injection of air and fluid. Quincke's plan is to introduce a common syringe between an irrigator and a double tube, which is conveyed into the pleural cavity, so that its longer limb shall be connected with the pipe of the irrigator, and its shorter limb with one arm of the double tube. If the tube is carried as deep as possible into the pleural cavity, and the syringe left standing upright in the usual manner, then, as the fluid flows out of the irrigator, the air is drawn through the short shank into the pleural sac; and in proportion as the air is drawn into the pleural cavity the fluid in the cavity is driven out through the

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[1] Virch. Archiv, IX., p. 254.

[2] Lehrbuch der Chirurgie, III., p. 637.

[3] Naturforscher-Versammlung in Giessen, 1864.

free arm of the double tube. The fluid will continue to flow out so long as the level of the fluid in the pleural sac remains above the inner opening of the outflow tube ; it is advisable, therefore, to bring it to as sloping a point as possible. In the mean time the syringe has more or less completely filled itself with the irrigation fluid out of the irrigator, and if we now turn it round, while the canula is drawn so far back that its mouth comes close behind the syringe, then the fluid streams out of it into the pleural cavity. The more frequently these manipulations are performed in succession, the more complete will be the cleansing of the pleural cavity, especially if the operator, following Quincke's advice, for this purpose closes the pleural incision quite air-tight by an India-rubber ring pessary.

But the whole of this method (and Potain's plan is very similar to Quincke's) has this obvious disadvantage, that if the outflow is checked from any unforeseen cause, the pressure in the pleural sac may become so great that not only may those adhesions which have possibly taken place be soon torn asunder, but the life of the patient may even be seriously endangered ; and, in the second place, the pleural cavity is never so thoroughly cleansed as in the process I have already described, and therefore a putrid decomposition of the residue of the exudation is quite possible.

The treatment that is adopted must afford the distinct guarantee that no pus is left anywhere in the pleural cavity to undergo decomposition. It is therefore of the first importance *that the opening into the pleural sac should be a large one.*

It is true that the danger of wounding the intercostal artery, or a considerable branch of it, is increased by a large incision. The first I have never seen, and it can always be avoided, if the operator is careful to keep as much as possible in the middle between two ribs. The latter, on the other hand, has happened to me twice ; and in one case, when, on account of great muscular development, the wound was very deep, considerable hemorrhage occurred before we were able to stop it. We can scarcely ever succeed in ligaturing the bleeding vessel ; we must therefore trust to compression to arrest the hemorrhage, taking care that the bleeding does not continue, behind the plug, into

the pleural sac. Should the intercostal space be so narrow that it is difficult to introduce the knife between the ribs, and that the wounding of the trunk itself of the intercostal artery could not with certainty be avoided—a condition that we sometimes observe after long continued pleurisy, especially in children—in that case we must not attempt to carry out the radical operation by simple incision, which would be ineffectual on account of the impossibility of subsequently cleansing the pleural cavity. It is better at once to resect a portion of a rib large enough to allow of the convenient introduction of the silver canula we have described above. In children, in certain very rare cases, when the ribs lie close together, it is necessary to remove a portion of two ribs.

Having made a sufficient opening into the pleural cavity, with or without the resection of a rib, if it seems desirable to keep it so far open that every time we wish we can cleanse it completely, then, in the first place, we must introduce into the wound a circular metal canula of the form described above, and leave it there night and day. Only in this way can we prevent that steady, rapid, and forcible spontaneous approach of the ribs to one another, which plugs of lint, catheters, and the like are quite unable to prevent. If the canula has not been quite securely fixed in the intercostal space, it may, possibly, over night be forced out of the wound, and then it can only be re-introduced the next morning with the greatest difficulty.

Even if a portion of a rib has been removed, yet if we do not insert a metal canula, the opening will very soon be so narrowed by the approach of the ribs that a sufficient cleansing of the pleural sac becomes impossible. This has led to some advising (as, for example, Roser[1]) that, in every radical operation for a purulent effusion, a rib should be resected, in order that the incision may be kept wide open; a bad piece of advice, as it not only does not secure the desired object, but also enhances considerably the danger of the operation by the presence of two wounds of bone.

Bardeleben[2] was the first to apply such tubes to the purpose

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[1] Archiv f. Physiol. Heilk, VI., 1.
[2] L. c., p. 637.

of keeping open wounds of the pleura, and Franz Hoffman [1] was the first to describe the process. Traube was the first to suggest that the canulas should be made sufficiently large to afford the means of cleansing the pleural cavity through them.

In order to avoid the inconveniences which arise from this tendency of openings into the pleural cavity to contract again, von Langenbeck has adopted the plan of trephining a rib, and he recommends it as leading to satisfactory results. "In this way injury to the intercostal nerves and arteries is avoided, and the pain in the wound in the rib is insignificant, and it is some time before any callus-formation commences." [2]   This method, which had been already practised by the disciples of Hippocrates and termed *terebration*, was especially recommended by Paræus and Severinus. Quite recently this operation has been again commended as an effectual one by Reybard and Sédillot. I do not recommend it myself, as the opening made is not large enough to admit of the thorough cleansing of the pleural sac. If an attempt is made to make it large enough for this purpose by trephining the rib in two different places, then the portion of rib lying between the two openings loses all support, and breaks down, as happened in the only case of double-trephining that has come to my knowledge.

The insertion of the canula is thus the most certain method of attaining our object. At first the patient is sometimes a little annoyed by the whistling sound made by the air as it passes by the tube in inspiration and expiration, but any infection of the pleural sac by the air which thus enters is rendered impossible by the Lister's bandage. If, however, the wound granulates completely, as is usually the case after about eight days, the canula then comes to fit air-tight in the wound, and this annoyance to the patient ceases.

This method of cleansing the pleural cavity, especially when the patient can lie in such a position that the wound in the pleura occupies the highest position in the thorax, thus allowing the fluid from the irrigator to reach every part of the pleural cavity, I maintain is the only one which affords a guarantee that

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[1] Ueber Empyem, etc., Berl. klin. Wochenschrift, 1869, p. 526.
[2] Deutsche militärärztliche Zeitschrift, 1874, p. 366.

no pus can become stagnant therein, always supposing that Nélaton's catheters are long enough to reach to the deepest parts of the pleural sac. But special attention must be paid to this point. I have often heard my most esteemed colleagues, to whom, when looking on at the after-treatment of such cases, the whole process of cleansing the pleural cavity has appeared a troublesome and useless waste of time, object, that by simply allowing the disinfecting fluid to run through a catheter *à double courant* inserted into the pleural sac, it could be cleaned out more rapidly and just as thoroughly ; if the water flowed out pure, it was evidence that the pus had been removed. The direct trial proves the absurdity of this objection ; for if, when the water flowing out of the *catheter à double courant* is quite clear, we introduce a Nélaton's catheter into the bottom of the pleural cavity, and then connect it with an aspirator, we can frequently withdraw one or two syringefuls of pus, which has gravitated to the most dependent parts of the sac. Nélaton's catheters are the best to use because they are the softest, and therefore least likely to injure or separate any adhesions of the pleura which already exist, when we are obliged to push them onwards through canals already narrowed and filled with granulations, or perhaps over the greatly elevated diaphragm.

> Since, in the progress of the case, the diaphragm frequently returns, at least to some extent, to its normal position, while pus still collects in the posterior part of the pleural sac, it appears especially advisable to make the incision not lower down than the fifth interspace ; for if the wound is made lower down, it is sometimes impossible to reach with the catheter, across the diaphragm, to the purulent accumulations behind it.

For the purpose of introducing the catheter, we leave the silver canula lying in the wound, to avoid the irritation which the contact of the India-rubber would cause.

In the whole after-treatment we must, in the first place, be guided by the temperature of the patient. After the pus is let out, the patient, as soon as the effect of the chloroform has passed away, feels himself very much relieved and free from fever. Should a rise of temperature occur in the next few days, it is to be feared that there is a stagnation of pus some-

where; if we then repeat the washing out more thoroughly, we sometimes succeed in discovering the spot where the pus has accumulated. If the pus has already a putrid odor, disinfecting solutions must be immediately employed, or those already in use strengthened; and we must repeat the washing-out of the pleural sac not merely twice, but three, four, or five times a day. Should all these efforts prove fruitless, should the patient again become feverish, the contents of the pleural cavity become still more fetid, the appearance of the wound still worse, the general debility progressive, then we may safely assume that more severe progressive affections of the pleura itself, especially tuberculosis, are imminent, and that we may anticipate with certainty a fatal result. I have never myself seen, since I have adopted the plan of treatment I have here described, such a fatal result in an uncomplicated case of purulent pleuritis. A putrid odor of the pus secreted by the pleura, however, appears not only in severe affections of that membrane, but also during slight gastric disturbances, and generally also in slight feverish conditions, but then it generally disappears entirely after one or two days.

At all events such a patient must be treated with the greatest watchfulness and care until after the removal of the canula. If we make the slightest concession in the treatment of the patient, because perhaps he is very sensitive, or for other reasons, the progress of recovery may not only be actually retarded, but it may be disturbed to such an extent that a thoracic fistula may eventually be left behind. In one of the cases I have already mentioned this result followed, because I allowed myself to be persuaded to remove the canula before the proper time, out of regard for the patient, who was constantly complaining of severe pain in the wound.

Finally, the question remains to be considered, How does such a purulent pleuritis heal, and how does the previously completely compressed lung become again permeable to air? Fortunately, as I have not had an opportunity of dissecting any one of those who have been cured by radical operation, or to lose any of those who have remained under my observation, of an intercurrent affection, I can only answer the question theoret-

ically, and with reference to the abundant granulation forma-
tions which we observe in these cases in the pleural cavity.

I believe that the whole of the pleura pulmonalis and cos-
talis, after it has thrown off the various necrosed masses lying
upon it, becomes covered with granulations, and at first those
which lie close to one another become here and there adherent.
These adhesions appear to commence most frequently near the
root of the lungs, and spread from thence; whilst the hitherto
compressed lung, by fits of coughing and other expiratory
efforts, with a more or less closed glottis, fills itself with air
from the sound lung.

When the adhesion of the pleural layers and the healing of
the external wound are complete, there yet remains, for a long
time, a considerable retraction of the affected side, during inspi-
ration, compared with the sound side; and especially over the
lower parts of the lung which have been compressed, the reso-
nance on percussion is greatly diminished, while over the upper
part it is scarcely less loud than natural; vesicular breathing
may be heard above, but below the breath-sound is indistinct or
very nearly absent. All these symptoms slowly but steadily
diminish if we make such patients practise a sort of lung gym-
nastic; at first, in their own rooms, placing their arms upon a
table or chair to fix the thorax, and then taking from twenty to
thirty deep inspirations; this should be done six or eight times a
day; afterwards, to promote the further expansion of the lung,
they should for several weeks take up their abode in a high
mountain district, where, free from work and with good food,
they can daily spend many hours in the open air. If we see
such patients after the lapse of some months, we often find that
the scar of the operation is the only remaining sign of their
former serious illness; even the edges of the lungs are again
normal and expand freely. We cannot explain how all this
happens until we have accurate pathologico-anatomical observa-
tions to guide us. For the present we must be content with the
fact that we can see such patients, who four or six months pre-
viously would certainly have died if left to themselves, cured,
entirely through our treatment, in this comparatively short time.
It is true that one such case demands endless time and trouble,

but the consciousness of having preserved a human life through our own skill alone, compensates the physician richly for his pains, and fills him with just pride.

HYDROTHORAX.

J. Frank, Præcepta, Pars II., Vol. II., Sect. I.—*Copland*, Dictionary of Practical Medicine, Vol. III. London. 1858.—*Trousset*, Mémoire sur l'hydrothorax. Montpellier, 1806.—*Comte*, De l'hydropsie de la poitrine et des palpitations du cœur. Paris, 1822.—*Schroeder van der Kolk*, Sammlung auserlesener Abhandlungen XXXVI.—*Ziemssen*, Die Punktion des Hydrothorax, Deutsch. Arch. f. klin. Medicin, V., S. 457 et seq.

Most of the works enumerated under the head of pleuritis are also to be referred to in reference to hydrothorax.

Introductory Observations.

By hydrothorax we understand the accumulation of a transudation, a so-called dropsical fluid, into one or both pleural cavities—the latter is the more common—without the existence of any inflammatory process in the pleural sac. Since we are in the habit of calling these non-inflammatory collections of serous fluid dropsical, then the correct name for hydrothorax is *dropsy of the chest*, or *dropsy of the pleura*, terms which are often erroneously employed to designate inflammatory effusions into the pleural sac. The pleural exudation therefore contains, it is unnecessary to say, no admixture of fibrine, or of pus corpuscles, or the like.

History.

In former times, before the existence of accurate pathologico-anatomical knowledge of disease, and before physicians had become familiar with physical methods of investigation, it sufficed for a patient to complain of dyspnœa, aggravated in assuming a horizontal position, or by the slightest exertion, or on starting out of his sleep, or who showed signs of incipient dropsy about the joints and eyelids, to diagnosticate the existence of hydrothorax.[1]

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[1] *J. Frank*, Præcepta, Part II., Vol. II., Sect. I., p. 676 et seq.

How unfounded such a diagnosis appears to us nowadays it is scarcely necessary here to remark ; but it is deserving of observation that at that time, and with physicians for whom medicine did not form a part of natural science, the diagnosis of dropsy of the pleura and pericardium played a prominent rôle, while the cases were generally those of heart disease, chronic pulmonary catarrhs, emphysema of the lung, and the like. As scientific progress gradually made clear what is to be under· stood by hydrothorax, some physicians, as for instance, Monneret, Fleury, and in more recent times even Peter, supported by the slight or scarcely detectable chemical difference in the constitution of pleuritic exudations and transudations, quite lost sight of the distinction between them.

It is, however, unjustifiable to do this, as in the one case an inflammatory process exists, and in the other it does not. On the other hand, we must admit the truth of the view which regards hydrothorax not as a disease of itself, but only as one of the evidences of a general dropsical condition. It is only for the purpose of discussing the actual diagnostic and therapeutic distinctions between a pleuritic exudation and a transudation into the pleural cavity that we deem it practically serviceable to devote a separate chapter to the consideration of hydrothorax, in connection with inflammation of the pleura, for water in the chest never appears as a disease by itself.

Etiology.

All those conditions which are capable of producing general dropsy may also give rise to transudation into the pleural cavity as soon as the serous effusion extends to the upper part of the body. Since both pleural cavities are subject to the same conditions, we find hydrothorax limited to one side only in those instances where the other pleural cavity is obliterated by adhesions between the pleural folds.

If we consider more carefully the conditions under which the symptoms of general dropsy present themselves, we notice, in the first place, those rare cases in which a general dropsy attacks individuals who, when heated, have laid down on damp

ground, and perhaps slept there for hours, and in whom we are
unable to discover any local affection to account for the dropsy.
Hitherto I have had opportunities of seeing but very few cases
of this kind. In one such case there was an unmistakable
and not inconsiderable double-sided hydrothorax, which disap-
peared together with the disappearance of the general dropsy.
Secondly, to this class those scarlet-fever patients belong, in
whom in the course of the disease general dropsy appears, and
in many cases proves fatal, without the existence of any renal
affection or hydræmic condition. In such cases also, as the
dropsy increases, transudations into the pleural cavities are apt
to take place.

In the third place, hydrothorax appears in all those cases in
which a general dropsy, dependent on distinct and evident ana-
tomical changes within the body, reaches a considerable extent.
The general dropsy may arise either from direct obstruction to
the flow of lymph, and especially from compression of the tho-
racic duct in its upper part, which is sometimes caused by intra-
thoracic tumors ; or it may be the result of abnormally high
pressure in the general venous system ; or thirdly, it may arise
from a poorness of the blood-serum in solid constituents, and
especially in albumen.

Such tumors, compressing the thoracic duct, are exceedingly
rare. I have seen only one case of the kind fourteen years
ago.

General dropsy, together with hydrothorax, arises in con-
sequence of abnormally high pressure in the general venous
system, brought about in the first place, in a great number of
cases, by heart disease, with or without incompetence of the
valves, when compensatory effects fail and the right ventricle
empties itself so imperfectly that the blood is, in consequence,
dammed up in the right auricle and in the whole venous system.
In consequence of the abnormally high pressure in the veins, the
serum of the blood flows through their walls and accumu-
lates in the subcutaneous tissue, and in the different cavities of
the body. The same condition is developed in a considerable
number f cases of chronic disease of the lungs, in which the cir-
culation of blood in the lungs is interfered with, and then natur-

ally results a consequent blocking up of the blood in the right side of the heart, with the consequences we have just described.

Lastly, we see general dropsy, together with hydrothorax, come on in the course of inflammation of the kidneys, or other chronic diseases of these organs, as, for example, amyloid degeneration, in which there has been a loss of albumen for a long time, and the blood-serum has thereby been rendered poorer in solid constituents. This leads to the transudation of the serous fluid through the walls of the veins into the surrounding tissues. A great number of cachectic conditions are attended with analogous results, as, for instance, cancerous growths, leukæmia, intense malaria, long-continued dysentery, etc.

Hydrothorax is invariably only a symptom accompanying general dropsy, and it does not take place until there is no longer any room for the transuded fluid in the deeper portions of the subcutaneous tissue. Even the pressure of a tumor in the thorax, or cancer of the pleura itself, will scarcely ever be sufficient, as is maintained in the manual of Niemeyer-Seitz, to produce hydrothorax as the sole and earliest symptom of dropsy. In such a case, where we really find a fluid effusion in only one pleural cavity, it always remains to be determined, especially in cases of cancer of the pleura, whether it may or may not be due to an inflammatory affection.

Pathology.

Form and General Course of the Disease.

As hydrothorax is only an accompanying symptom of general dropsy, we can hardly speak of it as a distinct form of disease ; its course also depends entirely on the real character of the disease which causes it, and it therefore possesses no characteristic appearances.

Anatomical Changes.

In water on the chest we have always to deal with a free collection of serous fluid in one, or rather, with the exceptions mentioned above, in both pleural sacs. It is only when the transudation takes place into a pleural cavity which is subdivided

into sac-like compartments by old adhesions of false membranes that we can speak of *hydrothorax circumscriptus, saccatus* or *multilocularis.* The bands of connective tissue which attach the pleural layers to one another are generally at the same time the seat of serous infiltration. The collected fluid is generally of a bright yellow or yellowish-green color, and transparent. So soon as it appears turbid, and shows an admixture of blood-corpuscles, flakes of fibrine, and the like—and such descriptions of dropsical effusions we very often find even in modern literature—it is with an exudation we have to do, and not a transudation. The quantity of dropsical fluid effused varies from a quarter to nine kilogrammes (from nine to three hundred ounces). We must be careful not to consider the few ounces of serous fluid which we find in dissections in almost every pleural cavity, as anything more than a simple *post-mortem* appearance. Whether it is really the case, as Wintrich[1] maintains, that in hydrothorax there is a greater accumulation of fluid on the right side than on the left, I cannot venture positively to decide, as I have undertaken but few comparative measurements. Where I have done so, I have not found Wintrich's statement confirmed, but have always found the greater quantity on that side on which the patient lay towards the close of life.

The subpleural connective tissue is often swollen and variously thickened by watery infiltrations, and is easily torn asunder; for the same reason the pleura itself is thicker and more sodden, it has lost somewhat its transparency, and has become opalescent. The lung is more or less compressed in proportion to the quantity of effusion, and its color depends on the amount of blood it contains, varying from pale gray to reddish brown. In many cases it is œdematous. Its retraction and compression toward the root follow more regularly than in pleuritis. By inflation the lung may be expanded to its ordinary capacity, unless any existing lung affection prevents it.

Moreover, we shall be able to discover on autopsy the very various anatomical changes upon which the general dropsy has depended.

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[1] L. c., p. 366.

Symptoms.

It is often difficult to distinguish the symptoms of pleuritis from those of hydrothorax; in other instances it is easier.

In the first place, hydrothorax runs its course without fever; there is often no cough; sometimes there is cough accompanied with expectoration of thin, watery, and—after violent coughing—frothy mucus. The cough is never so violent as in some cases of pleuritis. The intercostal pain is altogether absent.

Hydrothorax is, as we have already mentioned, with few exceptions, double-sided, while pleuritic exudation is one-sided; the displacement of the diaphragm, of the heart, of the mediastinum, the expansion of the wall of the chest etc., never stands out so evidently, for the double-sidedness of the pleuritic effusion and the accumulation of serous fluid in the abdominal cavity prevent an actual displacement of adjacent organs, and the expansion of the walls of the chest is concealed by the coexisting œdema of the subcutaneous tissue. In percussion we observe that the fluid contained in the pleural sac follows the law of gravity, so that the area of dulness is never bounded by a curved line, as in the case of exudations. In other respects the auscultatory and percussion signs are the same in both cases. On the other hand, the mechanical interference with respiration is greater than in pleuritic exudation, for hydrothorax is on both sides and occurs in individuals whose breathing power is already diminished by the conditions which have given rise to the general dropsy (diseases of the heart or lungs, anæmia, and hydræmia), and their difficulty of breathing is very much increased by the hindrances to the circulation caused by the hydrothorax. Such patients, therefore, are subject to attacks of extreme dyspnœa immediately they assume a horizontal position, or when they suddenly change their position, or move quickly, or cough, or cry out or speak loudly.

The general symptoms are, almost exclusively, those of the primary disease, upon which the general dropsy depends.

Complications and Sequelæ.

These cannot enter into the consideration of hydrothorax, which is itself only a symptom of other conditions of disease.

The diagnosis will naturally be determined by a consideration of the symptoms above described, which will enable us to distinguish it from a pleuritic exudation, with which alone it would be possible to confound it.

Duration, Results, and Prognosis.

The primary organic disease upon which the hydrothorax depends will also determine its duration, results, and prognosis. If the original malady is removed, as we very often find to be the case in renal diseases, then the water on the chest may also entirely disappear. If, on the other hand, the obstruction to the circulation increases more and more in consequence of the original disease, the hydrothorax, through compression of the lungs, may frequently prove the immediate cause of death. The prognosis therefore depends entirely on the nature of the original malady.

Treatment.

The treatment must, in the first place, be directed to the relief of the primary ailment, and not until this proves useless must we think of attempting to palliate symptoms in order to prolong the patient's life.

Ziemssen has recommended for this purpose, founded on a series of favorable observations, that we should puncture the pleural cavity with a fine trocar, and let out the serous accumulation. I think it better in such cases, and less trying to the patient, when the hydrothorax first appears, if the subcutaneous tissue of the lower half of the body and the abdominal cavity are distended with serous fluid, to make a couple of simple incisions into the subcutaneous tissue, and while the serum is flowing off to protect the wounds from infection by suitable outward applications.

Quite recently I have seen, in Traube's clinic here, the opera-

tion judiciously modified in this way : Little metallic canulas are placed in the wounds, such as are used with Pravaz's syringes ; these are simply provided with a number of lateral openings, and a caoutchouc tube is attached through which the dropsical fluid flows off.

In this way we may often succeed, even when the original disease is incurable, in causing the dropsy almost completely to disappear for months, and in keeping the patient in relative ease, whereas the evacuation of one or other pleural cavity by puncture can only have quite a transitory effect. For the dropsy will always rise again from below and refill the pleural cavities, whereas when permanent channels for outflow are fixed at the lower extremities, and kept open, the development of dropsy in the higher parts of the body becomes impossible. In all such cases we must endeavor at the same time to maintain the strength of the patient by a light nutritious diet, accompanied with small quantities of beer and wine, and strengthening medicines, such as the preparations of quinine and the like.

HÆMATOTHORAX.

Marcellus Donatus, Lib. III., cap. 9, p. 263.—*Morgagni*, De sedibus et causis morborum, Epist. IX., 4 ; Epist. XVII., 17 ; and Epist. XXVI., 3, 11, 17, 29.—*Stoll*, Ratio medendi, Vol. VII., p. 96.—*Lieutaud*, Histoire anat. médic. ; observ. 794, 795, 798, and 922.—*Portal*, Cours d'anat. médicale, III., p. 354.—*Frank*, Interpretationes clinic., I., p. 379.—*Sédillot*, Sur l'opération de l'empyème. Thèse de Paris, 1841. And other authors mentioned under Pleuritis.

By hæmatothorax is meant an effusion and accumulation of blood in one or other pleural sac, without any inflammatory affection of the pleura. We must never, therefore, confound hemorrhagic pleuritic exudation with hæmatothorax.

Etiology.

Hæmatothorax is always a secondary affection, and occurs in very rare cases from internal causes, especially when an aneurism of the aorta, after having attained a great size, bursts into the pleural cavity. This generally happens on the left side,

very rarely on the right.   Moreover, the aorta may, without the
formation of an aneurism, be also laid open by ulceration, as
described by Morgagni and Portal, and in this way lead to an
effusion of blood into the pleural cavity.   The same, it is said,
may happen in some rare cases from the veins of the lungs, the
vena cava (Portal [1]), and, as Caldani [2] maintains, even out of vari-
cose veins on the pleural surfaces.

In very rare instances, in the cavities that form after caseous
pneumonia, or in gangrene of the lung, a profuse bleeding takes
place, destroys the lung tissue, and, breaking through the pleura
pulmonalis, finds its way into the pleural cavity.   Wintrich [3]
also mentions a case in which hæmatopleura arose through
destructive caries of the ribs, with erosion of an intercostal
artery and breaking through of the pleura costalis.   The most
frequent causes, however, are external, especially penetrating
wounds of the chest ; sometimes contusion of the lungs, when
followed by great effusion of blood into the tissue of the lung
and laceration of the pleura pulmonalis.

Pathology.

When hæmatothorax is not quickly fatal through the causes
which produce it, it runs its course—we are speaking only of
traumatic cases—usually to a favorable result, through entire
absorption of the hemorrhage.

The attack is sudden ; the patient, without any immediately
discoverable outward cause, is suddenly attacked with intense
pain in the affected side, and a sensation of great loss of strength,
often amounting to fainting, while he turns pale, his extremities
become cold, and cold perspiration covers his body.   Either this
condition terminates directly in death, or the patient wakes out
of his fainting fit, his extremities again become warm, and his
lips only remain pale.   He complains of an intense feeling of
oppression on the chest.   Slowly this feeling becomes less, and
his strength gradually returns.   Thus by degrees recovery sets

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[1] L. c., III., p. 354.

[2] L. c., XII., p. 2.

[3] L. c., p. 364.

in ; but sometimes, ten or fourteen days after the commencement of the illness, slight symptoms of an incipient pleuritis arise ; these, however, generally disappear pretty soon.

Anatomical Changes.

The anatomical changes found on dissection will, apart from the hemorrhagic effusion in the pleural cavity, depend entirely on the nature of the primary disease.   Wintrich [1] has performed various experiments on rabbits, dogs, and cats, for the purpose of producing in them artificially a hæmato-pneumothorax ; but from two to eight days after the infliction of the wound he always found the blood had completely disappeared, and he was not able to discover even a pigment formation as a residuum. The air also was absorbed.   Lungs and pleura, with the exception of the spot wounded, were as much intact as if nothing whatever had happened.

Symptoms.

The general symptoms of hæmatothorax depend, as we have already said, partly on the causes of the hemorrhage, and partly on the direct effects which it may have produced ; later on, however, slight signs of pleuritis are added to these.   We have already said that pain and dyspnœa accompany the onset of the hemorrhage.   The physical signs are the same as in all collections of fluid in the pleural sac, and vary therefore according to the amount of the hemorrhage, the yieldingness of the chest wall and of the adjacent organs.   A more detailed account of these phenomena would only be a repetition of what has been already said in the chapter on Pleuritis.

Complications and Sequelæ.

Since hæmatothorax is always but a complication of other diseases, it is inconsistent to regard (as some do) the latter as complications of the former.   In most cases dependent on a traumatic cause, air enters the pleural sac at the same time, and

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[1] L. c., p. 363.

from the first we have to deal with a hæmato-pneumothorax ; and this—when pleuritis follows, and the extravasated blood, meeting with a purulent pleuritic exudation, undergoes decomposition or becomes wholly ichorous—terminates in a pyopneumothorax. If the hæmatothorax is not complicated with pneumothorax, it is yet apt, after a time, to be attended by pleuritis. This, however, rarely assumes a great extent, but if it once occurs, it may naturally be followed by the same secondary diseases as in pleuritis arising from any other cause.

Diagnosis.

There is nothing . more to be added under this head to what has already been said in speaking of the diagnosis of pleuritis and hydrothorax, and specially in the first section on the differential diagnosis from hæmatothorax.

Duration, Results, and Prognosis.

The duration, results, and prognosis of hæmatothorax depend, essentially, on its causes, its casual complications, and the entrance of air into the pleural sac. If it is caused by the rupture of an aneurism, a fatal result usually follows very quickly. In traumatic hæmatothorax, without at the same time the occurrence of any dangerous wounds and concussions of other organs, the course, and therefore the prognosis, is for the most part favorable ; generally complete absorption of the effusion takes place in from eight days to three or four weeks. When it is complicated with pneumothorax or with secondary pleuritis, the prognosis depends on these affections and not on the hemorrhage.

Therapeutics.

The first object of treatment must be to arrest the hemorrhage and prevent its return. The patient must be enjoined absolute rest. If this cannot be obtained in any other way, small doses of morphine must be administered hypodermically, even should the respiration be somewhat embarrassed, for the

slightest movement of the patient may directly endanger his life, by leading to a renewal of the hemorrhage. At the same time a bladder of ice should be applied to the affected side of the chest and a strictly antiphlogistic diet prescribed. Subcutaneous injections of ergotine (from one and a half to two grains at each dose) may be tried in case of need, without, however, expecting too much from them. Yet they have acted successfully in several cases. If there is no further danger of a return of the hemorrhage, all further treatment must be directed to the primary disease; in simple traumatic hæmatothorax all further medical treatment, besides rest, is superfluous. But occasionally at the onset of the attack, owing to the magnitude of the hemorrhage, there is obvious danger of suffocation which compels us to act. In such cases the opening of the pleural cavity by incision has been warmly recommended and successfully carried out by the most eminent military surgeons.[1] Larrey, for example, has repeatedly performed this operation with success, but has always removed only a small quantity of blood, just enough to remove the dangerous pressure on the heart and the other lung; he never removed as much blood as possible, because he rightly judged that the remaining blood exercised a beneficial mechanical pressure on the wounded vessel, and so prevented, as much as possible, the return of the hemorrhage. Larrey's advice, in my opinion, deserves the fullest consideration, especially in cases of gunshot wounds of the pleural cavity, since no kind of injurious consequences can result from incision into a pleural sac already permeable to air. In the year 1870, I myself, in the field-hospital, had the care of two gunshot wounds attended by hemorrhage into the pleural cavity greatly endangering the lives of the patients. I made a tolerably large incision into the pleural sac in each case, and let out a portion of the coagulated blood. One of these cases I know for certain made a perfect recovery, the other I left in a very favorable condition ten days after the incision, but I have not been able to procure further information about him.

Should pleuritis or pyopneumothorax arise in the course of

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[1] *Wintrich*, l. c., p. 365.

a hæmatothorax, these processes must of course be met by appropriate therapeutic measures.

PNEUMOTHORAX.

Itard, Sur le pneumothorax ou les congestions qui se forment dans la poitrine. Thèse de Paris, 1803.—*Piorry*, Dictionn. des scienc. médic., T. XLIV., p. 370. —*Davy*, Philosoph. Transactions, II.—*Bierre de Boismont*, Thèse de Paris, 1825.—*Louis*, Recherches sur la phthisie. Paris, 1825.—*Laënnec*, Traité de l'auscultation mediate, 1831, III.—*Martin Solon*, Arch. Génér., IX., pp. 468–469, 1835.—*Siebert*, Allg. medic. Zeitung, 1835.—*Stokes*, Dubl. Journ., November, 1849.—*James Haughton*, Encyclopädie der praktischen Medicin, Deutsch von Fraenkel. Berlin, 1840, Bd. III., pp. 523–531.—*Puchelt*, Doppelter Pneumothorax, Heidelberger medic. Annalen, Vol. VII., No. 4.—*Saussier*, Recherches sur le pneumothorax. Thèse de Paris, 1841.—*Mohr*, A Case of Perforation of an enlarged Bronchus, Berl. Medic. Centralzeitung, 1842, No. 25 ; a second analogous case, eodem loco No. 29.—*Hughes*, Twelve Cases of Pneumothorax, Lond. Med. Gaz., 1844.—*Chomel*, Du pneumothorax, Gaz. des Hopitaux, 1845, Nos. 144 and 148.—*Jul. Hotte*, Ueber Pneumothorax. Inaugural Dissertation. Würzburg, 1848.—*Hamilton Roe*, Paracentesis in Pneumothorax, Lond. Med. Gaz., April, 1849.—*Rumpf*, Ueber Pneumothorax. Inaugural Dissertation. Würzburg, 1849.—*Günsburg*, Ueber Pneumothorax. Dessen Zeitschrift, III., 1852.—*Woillez*, La Guérison de Pneumothorax, Arch. génér., Dec., 1853.— *Redar*, Ein Beitrag zur Aetiologie des Pneumothorax, Berl. klin. Wochenschr., 1866, No. 39.—*Curling*, Case of Traumatic Pneumothorax, Paracentesis, Recovery, Med. Times and Gaz., 1867, Oct. 26.—*von Oppolzer*, Klinische Vorlesungen über Pneumothorax, Wiener med. Presse, 1869, 31–34.—*von Oppolzer*, Ein interessanter Fall von Pneumothorax, Allg. Wiener med. Zeitung, 1868, No. 52.—*Ramskill*, Two Cases of Pneumothorax treated by Aspiration, Lancet, 1871, Aug. 19.—*Baerensprung*, *II.*, Zur operativen Behandlung des Pneumothorax. Berlin. Inaugural Dissertation, 1873.—*Tanné*, Contribution à l'étude du traitement de l'hydropneumothorax par la ponction de la poitrine et les lavages de la plèvre, Gaz. hebdom., 1873, No. 33.—*Ewald*, *A.* Untersuchungen zur Gasometrie der Transsudate des Menschen, Reichert's and Du Bois-Reymond's Archiv, 1873, No. 6.—Compare also the collected literature of Pleuritis.

Introductory Remarks.

The collection of any kind of gas in the pleural sac we call pneumothorax. If pus or blood should be present, before the entrance of air into the pleural cavity, we speak of a pyo-pneumothorax, or a hemato-pneumothorax ; but if, on the con-

trary, pus or blood enter the pleural sac at a later period, when it is already filled with air, then it is a case of pneumopyothorax, or pneumohæmatothorax ; but in ordinary medical phraseology these distinctions are not always carefully preserved.

History.

Mention has been made incidentally by some of the older anatomists, such as Morgagni, Merkel, and others, of collections of gas having been occasionally found in the pleural cavities. Itard, who is said to have composed his work under the influence of Bayle, was the first to describe the accumulation of air in one or other of the pleural sacs as a substantive disease, and to give it the name of pneumothorax. His view, indeed, as to the mode of origin of the disease is not very accurate, for he seems to have seen it developed only in this way, viz., as a residuum in the pleural cavity after the absorption of a pleuritic exudation. Laënnec is the first to whom we owe an exact anatomical and clinical description of pneumothorax, and observers who have followed him have completed and extended his description but in a few points only, and those chiefly in respect of the percussion signs.

Etiology.

The opinion has now long been rejected which prevailed in the first decades of this century, that air is secreted by the pleural surface, when it is intact, and accumulates in the pleural cavity ; a few physicians, however, still believe that gas may be generated in the pleural sac from decomposition of a purulent exudation therein, without the entrance of air. No direct proof has ever been adduced of the origin of pneumothorax in this way ; indeed, it appears clear from the researches of Ewald [1] that no development of gas can ever take place in such a manner. There can be no doubt, therefore, that pneumothorax is always a secondary affection, and only arises when the pleura is so destroyed at some one spot that air can enter the pleural sac from without, or through the pulmonary alveoli or the bronchia.

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[1] Reichert's and Du Bois's Arch., 1873, No. 6.

Among the causes which produce such perforations, external injuries must, in the first place, be mentioned ; as, for instance, penetrating wounds of the outer chest wall, wounds produced artificially in the radical operation for empyemas, and so-called "penetrating" wounds of the chest, by which sometimes only the external soft parts and the pleura costalis, sometimes also the pleura pulmonalis with the tissue of the lung, are lacerated. Sometimes, as in gunshot wounds, this kind of injury is inflicted on two different parts of the chest, the ball penetrating the lung on one side and coming out on the other. Thirdly, pneumothorax may occur when, without any injury to the external soft parts, the lung and the pulmonary pleura are lacerated by the sharp, piercing ends of broken ribs. If the perforation of the pleura costalis which occurs at the same time does not immediately close, more or less extensive emphysema of the subcutaneous tissue will follow. Lastly, laceration of the lung tissue, and consequent pneumothorax, may take place, while the ribs and pleura costalis remain quite intact ; as in violent contusions of the thorax from severe blows, or falling with one's horse, or being driven over, or the thorax being jammed by carriages, machinery, or such like. In these cases the external force is sometimes not very great. I remember a case of pneumothorax which came on in a young merchant, nineteen years of age, who persisted in rolling a tolerably heavy barrel farther than his strength permitted. While doing this, and without the barrel having ever touched his chest, he had suddenly, when exerting himself the most, a feeling as of something having given way in his chest ; he became short of breath and unable to go on with the exercise. The pneumothorax disappeared in about six weeks, and the lungs never showed any discernible pathological changes. Thus, with lung tissues evidently intact, the above-mentioned not very considerable exertion was sufficient to produce pneumothorax.

Apart from these various traumatic causes, most of which are dependent on outward casualties, Laënnec has rightly insisted that the internal disease which most frequently leads to pneumothorax is pulmonary tuberculosis, or, as we must now say, after the successful elucidation of the pathologico-anatomi-

cal appearances, caseous pneumonia, when decomposition of the caseous masses occurs in any portion of the surface of the lungs. This decomposition, or, in other words, the formation of cavities, must take place pretty rapidly, or else some circumstances must exist which prevent the thickening of the portion of pleura pulmonalis lying over the small cavity, or hinder its adhesion with the pleura costalis. The thin covering of the lungs offers so slight a resistance to an abnormally great expiratory pressure, such as may be caused, for instance, by fits of coughing, or by straining at stool, or by any other kind of bodily effort, that it is then easily ruptured, and air passes from the pulmonary tissue into the pleural cavity. Therefore, in consumptive people violent fits of coughing and straining at stool are the most frequent immediate causes of pneumothorax. It is frequently maintained, by Niemeyer-Seitz for example, that it arises more frequently in pulmonary disease which runs a rapid, subacute course, than in chronic processes of the same kind ; but, in my opinion, this is incorrect. At least, in my department in the Charité, where every year fifteen or sixteen cases of pneumothorax come under post-mortem observation, most of which have arisen in the hospital itself, I find, in the majority of cases, the escape of air into the pleural sac takes place in advanced caseous pneumonia running quite a chronic course. Certainly in many cases it does not come on till they are very much exhausted by the illness, and within twenty-four or forty-eight hours of obviously approaching death, in which case it may easily be overlooked, since the symptoms, as we shall discuss in detail further on, are by no means conspicuous.

Caseous pneumonia is frequently followed by empyema, and this may become the cause of pneumothorax, not by the spontaneous development of gases from the exudation, but by the exudation breaking through the pleura pulmonalis into the bronchia. If the pus makes its way out through an intercostal space, the narrowness and tortuousness of the fistulous passage, and the distance of the outer from the inner opening, prevent the entrance of air into the pleural sac.

It would well repay the trouble if more exact statistical tables were drawn up as to the causes of pneumothorax, in

which, as Wintrich justly remarks, a much more prominent rôle must be assigned to caseous pneumonia, in the etiology of pneumothorax, than has hitherto been assigned to it. The numbers, as Saussier gives them, supported on an analysis of 131 cases in which pneumothorax occurred, evidently give a too small comparative proportion to pulmonary consumption.

From pulmonary consumption........... 81 times.
"   empyema......................... 29   "
"   gangrene........................ 7   "
"   pulmonary emphysema............ 5   "
"   "   apoplexy.............. 3   "
"   hydatids.... 1   "
"   hæmatothorax.................... 1   "
"   abscess in the lung............... 1   "
"   cancerous ulcer.................. 1   "
"   hepatic fistula communicating with
            lung.... 2   "

The mode of distributing patients in the different sections of the Charité, by which the greatest number of consumptive patients are to be found in my division, makes it impossible for me to oppose to these numbers a statistical table of my own which would not run the risk of going into the opposite error; but approximatively I can, according to my own experience, venture to say, that of fifteen cases of pneumothorax one at most arises from empyema or other processes, and the remaining fourteen arise from vomicæ on the surface of the lungs, in the course of a caseous pneumonia.

Pneumothorax arises in connection with empyema in the following manner: when, by an expiratory movement, the first pus which escapes into the lung through the perforated pleura pulmonalis is discharged externally, in the succeeding inspiration, when the thorax again expands, a corresponding amount of air is drawn into the pleural cavity. In this way a pyothorax becomes a pyopneumothorax. But from what has been said already as to the result of purulent pleuritic exudations, it will be evident that pneumothorax does not invariably follow the discharge of the pus into the lungs and bronchia. Should it,

however, set in, it may, if adhesions between the pleural layers exist, sometimes occupy only a limited portion of the pleural cavity, and is then a *circumscribed pneumothorax*.

In a third series of cases it follows either direct necrosis of the pleura pulmonalis, or its ultimate laceration, when softening of the lung tissue extends to its surface. We see this in abscesses of the lung, and especially in gangrene of the lungs, when it attacks peripheral portions of the lung tissue. Abscesses of the lungs, which occur almost exclusively after pneumonias, and especially after such cases as are of traumatic origin, occupy usually a central position, and only very rarely lead to such extensive destruction of the lung tissue as to reach the pleural surface, and consequently but seldom cause laceration of this membrane and escape of gas into the pleural sac.

Also in cases of gangrene of lung occurring in connection with fibrinous pneumonia, and usually developing in the central portions of the lung, this circumstance seldom takes place. But sometimes even in this case, as I had an opportunity of seeing only a few months ago, the gangrene extends over the greater part of the inflamed lung, and reaches at last its surface, the pleura pulmonalis becomes necrosed, and then air, and with it a not inconsiderable quantity of gangrenous ichor, escapes into the pleural cavity. Somewhat more frequently pneumothorax arises in connection with bronchiectatic cavities lying quite near the periphery of the lung; these become the seat of a putrid bronchitis, ulcerations of the bronchial walls follow, and by the extension of the putrefactive process to the pulmonary tissue gangrene of the lungs is developed, and this spreads to the surface of the lung. Air, however, enters the pleural sac most frequently in those cases of gangrene of the lung which occur in consequence of infective emboli being arrested in the smaller peripheral branches of the pulmonary arteries, and by means of which small, wedge-shaped portions of lung tissue at the surface of the lungs become broken down. In such cases it is not unusual for the gangrene not to have been diagnosticated at all.

It is thus that pneumothorax arises in various kinds of surgical diseases, when infective emboli pass into the circulation. It is most difficult to prove the connection when it proceeds from

caries of the internal ear.   Ulcerative endocarditis and pyophle-
bitis may naturally in the same manner produce embolic gan-
grene of the lungs and pneumothorax.   We must enumerate
amongst the causes of pneumothorax the cases which, though
rare, certainly do occur, wherein emphysematously distended
alveoli, lying immediately under the pleura, give way, and the
pleura is at the same time lacerated.

Pneumothorax may arise from perforation of the œsophagus
in the posterior mediastinum, and simultaneous injury of the
pleura, an accident more especially produced by ulceration, and
chiefly cancerous ulceration, more rarely by the entrance of
pointed foreign bodies, and most rarely by spontaneous rupture ;
in this case the pneumothorax is complicated by the entrance of
various kinds of food into the pleural sac.

The following causes of the entrance of air into the pleural
cavity are very rarely met with : Suppurating bronchial glands
perforating both into the bronchi and through the mediastinum
into the pleura at the same time (in the few cases that have been
observed it has been into the left pleura) ; 2d, hydatids of the
lungs bursting into the pleural sac ; 3d, an abscess in the abdom-
inal cavity discharging itself, at the same time, through the dia-
phragm into the pleura, and into an abdominal organ perme-
able to air ; this has been observed to occur in an echinoccus
cyst of the liver, which burst simultaneously into the pleura and
the intestine.

Form and General Course of the Disease.

As pneumothorax is always a secondary affection, its form
will be specially modified according to the nature of the primary
malady.

In many instances it comes on in cases of advanced phthisis,
without any particular complaint on the part of the patient,
and without any decided aggravation of the previously existing
dyspnœa ; and it is only on a closer examination that we dis-
cover the presence of an accumulation of air in the pleural
cavity.   Generally, however, at the moment the pleura is lacer-
ated, even quite apart from traumatic cases, the patient has a

very distinct feeling as if something had given way in his chest. From that moment painful sensations are, for a long time, felt in the lower part of the chest on the affected side, and in fatal cases these continue till the end. Dyspnœa, increasing in intensity, and often becoming rapidly very distressing, sets in at the same time, and frequently a few minutes after the first feeling of pain the patients are obliged to sit upright, or to lie altogether on the affected side, in order to facilitate as much as possible free movement of the sound lung. At the same time deep cyanosis quickly appears, and sometimes in the first few days dropsical swelling of the face and limbs supervenes. The pulse becomes small, the extremities cold.

Sometimes patients die of acute collapse, or in consequence of the great impediment to respiration, a few hours after the occurrence of pneumothorax. In other cases death may not follow for days, weeks, or even months, especially when the secondary pleuritis develops in a regular manner, and is attended with abundant exudation. In such cases we now succeed in curing even those which are of the most serious nature, by making incision into the pleural cavity; and even in earlier times some simple cases of pneumothorax, even in phthisical patients, have been known to be completely cured, and this is generally the result in traumatic pneumothorax unattended with serious complications.

Anatomical Changes.

I cannot, of course, in this place enter minutely into the anatomical changes caused by the various primary processes of disease, but I can only mention those which are peculiar to pneumothorax as such.

We generally notice, even in the external examination of the corpse, a considerable expansion of one side of the thorax, especially at the lower part, with intercostal spaces much stretched and strained. As a rule, when we puncture the side of the thorax which contains the air, it escapes from the pleural cavity with a faint blowing or hissing sound. A little flame held in front of the opening is blown out. If we make the opening into the affected pleural cavity under water, or pass into it a per-

forated needle to which an India-rubber tube, opening under
water, is attached, the air escapes in separate bubbles. Some-
times, however, the pressure to which the air in the pleural
cavity is submitted is so slight that there is neither any bulging
of the affected side of the chest, nor, when the pleural cavity is
punctured, does the air escape under any noticeable pressure.

The amount of air in the pleural cavity varies from a few
cubic centimetres to two thousand and more. The more easily it
enters and the more difficult it is for it to escape, the greater will
be its amount (Wintrich). This we see when a moderate-sized
perforated opening in the pleura pulmonalis exists, over which
fibrinous coagulations, etc., lie and act like a valve, so that in
successive inspirations (all the more rapid on account of the dys-
pnœa) a certain amount of air rapidly escapes, and this goes on
until the greatest possible displacement of adjacent organs, and
of the thoracic walls, and the greatest possible degree of com-
pression of the affected lung are attained. The lung at first
recedes very rapidly by means of its power of retraction ; when
this is spent it becomes still more compressed if the air is pre-
vented from escaping again during expiration.

The extent of the accumulation of air in the pleural cavity
will depend on the following circumstances :

1. The compressibility of the lung, *i.e.*, the absence of any
disease rendering its tissue hard and incompressible ; 2. the
expansibility of the thoracic wall and the mobility of adjacent
organs, *i.e.*, the absence of any upward pressure from the abdo-
minal organs and the absence of any accidental ossification of the
costal cartilages ; 3. the capacity of the pleural sac itself ; and,
4. the less incompressible fluid (or only very slightly compres-
sible by the gas) it contains. Even when the perforation in the
pleural cavity is not covered by a fibrinous flap, making the
egress of air in expiration impossible, but allowing it to make
its way in inspiration, yet as the retraction of the lung advances
and the quantity of air increases, the pressure of the air alone
is sufficient to close the perforated openings, so that while air
can indeed make its way in during forced inspiration, it cannot
pass out again in expiration, and finally both are impossible.

The less the lung can contract and the more fluid there is

accumulated in the pleural cavity, the smaller will be the quantity of gas therein.

On analysis by Davy, Martin, Solon, and others, the gas collected in the pleural cavity appears to be composed chiefly of carbonic acid and nitrogen, and contains but little oxygen, besides also some sulphuretted hydrogen, if at the same time there should be an accumulation of ichorous pus in the pleural sac. It is, however, very rare for the pleural cavity to contain air exclusively,—according to Monneret and Fleury, only sixteen times in 147 cases. If the patient has survived the entrance of air into the pleural cavity for only a few days, pleuritis will generally be found to exist, and be attended with sero-purulent exudation, which increases rapidly in quantity, and with its increase in volume gradually presses more and more upon the air in the pleural cavity, until finally it may cause it to disappear altogether.

The question has been much discussed whether in these cases the entrance of air, as such, into the pleural cavity produces the purulent inflammation. This must be denied unconditionally in the case of air which is not charged with infective germs. If, however, we consider the origin of pneumothorax, we shall find that, as a rule, not only air, but also decomposed tissue-elements in greater or less quantity make their way into the pleural sac, and these must be regarded as the excitants of a purulent, or, as for example, when gangrenous ichor flows into the pleural cavity, of an ichorous inflammation. It is only in traumatic cases, or when very small quantities of decomposed lung tissue enter the pleura, that purulent inflammation is absent.

Supposing, now, that air alone, or air and fluid are in the pleural sac, we shall find the lung for the most part quite void of air, and reduced to a very small volume lying near the vertebral column. This is always its position, unless by old adhesions it has been fixed to some other part of the wall of the chest. Sometimes, in very rare cases, the perforated spot is found immediately on dissection, and is, occasionally, even as large as a five-groschen piece. In many other cases it is difficult to find, and it is only by inflating the lung under water that it can be discovered, as it is covered over with fibrinous deposits.

Finally, in other cases the opening, which may have been very small at first, is completely closed, and cannot be found again. Displacements of neighboring organs and distention of the wall of the chest are often more considerable in pneumothorax than in pleuritic effusions. These displacements are the same as I have already described under pleuritis, only that the heart is more frequently found displaced from before backwards, a very rare circumstance in pleuritic effusions.

Occasionally the escaped air is enclosed in a space of moderate extent, shut in on all sides by adhesions; then it is only the adjacent portions of the lung that are compressed, the thorax is only partially distended, the heart and the liver usually are not displaced; the diagnosis of a circumscribed pneumothorax is difficult during life.

Symptoms.

Pneumothorax, as such, is never attended with fever. We never, therefore, observe rises of temperature in connection with entrance of air into the pleural sac. Should they appear, then they have either existed before, and are manifestations of the original disease, or they are new, and, occurring in the course of pneumothorax, are signs of secondary pleuritis. Immediately, on the occurrence of pneumothorax, the temperature not infrequently sinks below the normal to 97° F., and under. This is always a bad sign, especially when associated with a considerable rise in the frequency of the pulse, up to 140 beats and more in the minute; but even without any remarkable sudden collapse, an accumulation of air in the pleural sac will almost always be attended by a considerable rise in the frequency of the pulse (from ten to twenty beats), at the same time the radial arteries will appear smaller and less tense, for, in consequence of the compression of the lung, there will be naturally less blood arriving in the left auricle and, therefore, in the left ventricle and the aortic system.

In the majority of cases, with the occurrence of pneumothorax, not only do the respirations become greatly increased in frequency, up to from forty to sixty in the minute, but also dyspnœa of the most severe and distressing kind sets in. In a not

inconsiderable number of cases, however, there is no dyspnœa, and even the respirations are scarcely increased in frequency; these are always very debilitated individuals, generally suffering from advanced phthisis, and on account of their bloodlessness the medulla oblongata is imperfectly nourished, and therefore of diminished excitability, and owing to the small amount of blood in circulation the greatest embarrassment of respiration is incapable of producing any considerable accumulation of carbonic acid in it, and so of abnormally exciting the respiratory nerve-centre in the medulla oblongata. We see, therefore, in these cases the same conditions come into operation as we have already more minutely described in pleuritis. The same amount of compression of the lung by pneumothorax will at one time produce the most formidable dyspnœa, while at another time scarcely any noticeable change in the condition of the patient occurs. Thus I often find in my department, amongst persons in advanced phthisis, whose respiratory organs I am induced to re-examine, either because of the position they assume, or because of the frequency of their pulse, or for some other reason, but not because they suffer from dyspnœa or make any particular complaint, that a pneumothorax exists, without being able to decide with any certainty the time of its first setting in. In such instances pneumothorax has come on quite imperceptibly, and has been attended with no kind of inconvenience to the patient.

Orthopnœa is generally combined with severe dyspnœa, as in pleuritic effusions, so long as the sensorium is unaffected and the strength of the patient is sufficient to support him in an upright position. This, however, is often not the case with consumptive patients, and towards the end of their life. Such patients are then observed to lie invariably on the affected side, in order to facilitate as much as possible free movements of the uncompressed lung; indeed many of them, in this position, have no dyspnœa whatever, but are attacked by it as soon as they are compelled to assume any other. These patients are evidently in transition to the condition just described, in which dyspnœa is altogether absent.

Quite peculiar positions will sometimes be assumed by indi-

vidual patients temporarily for the alleviation of their sufferings. Henoch has described a most striking instance of this: a man affected with pyopneumothorax lay on his back whenever his dyspnœa increased with an increase in the accumulation of pus in the pleural sac, and he, at the same time, kept the upper part of his chest lower than the under. Then he discharged, in a stream, a great quantity of pus from his mouth, and felt himself relieved for a long time. In this case dissection showed in the upper part of the lung a wide communication between the pleural cavity and a bronchus which had remained open in the compressed lung; the pus could pass into this opening only when the patient assumed the position described.

The pain observed in pneumothorax is generally too slight to influence the position of the patient, or to increase at all what dyspnœa may already exist. Most patients feel a decided pain the moment when air enters the pleural sac; they generally say that at this moment they have a feeling "as if something had given way in their chest;" others declare, according to Stokes and Louis, that they felt the entrance of air like a wind streaming from below upwards. This sudden feeling of pain can scarcely be explained by the laceration of the pleura pulmonalis, which, previously to this, is generally in a state of decay, but by the strong tension which the whole pleural sac experiences. Therefore the painful sensation never quite ceases during the early part of the illness, at least in the lower part of the affected side. Some days later there is often increase of pain with feverish symptoms; an indication that secondary pleuritis has supervened.

If the pneumothorax is altogether unattended with symptoms, or if the sensorium is affected, there is no complaint of pain.

Should the pneumothorax be attended with distressing dyspnœa, the voice is apt to become weaker and lisping, and even aphonia may sometimes be observed.

The presence or absence of cough and expectoration will depend on the cause of the pneumothorax. If it is caused by the perforation of a purulent exudation through the lung into a bronchus, and in place of the pus air enters the pleural sac, then

the pus is generally discharged from the mouth in streams, attended with most violent fits of coughing. Should the pneumothorax arise from some other cause, then the acute lung-insufficiency may so weaken or even annihilate the expiratory power that a vigorous cough becomes impossible.

Whenever pneumothorax is attended with much dyspnœa, more or less marked cyanosis frequently appears on the visible mucous membrane, as well as on the cheeks, nose, ears, and not seldom also on the hands and feet. If the difficulty and oppression of breathing are very great, the extremities and the tip of the nose become cold, cold clammy perspiration covers the skin, especially of the head, and at last the tongue, deeply cyanosed, becomes cold, and finally death ensues from suffocation. If, on the other hand, a patient with pneumothorax continues to live, notwithstanding an extreme amount of dyspnœa, then, after a few days, œdema of the face and extremities comes on, owing to the great venous obstruction. Sometimes, when pneumothorax has long existed, a general subcutaneous emphysema is developed, and is somewhat rapidly and widely diffused. This happens through the destruction, in some spot or other, of the pleura costalis, so that air from the pleural sac can reach the subcutaneous tissue. This emphysema is observed most strikingly in the case of rupture of the œsophagus, when laceration of the pleura and admission of air into the pleural cavity, and the diffusion of air through the subcutaneous tissue follow as simultaneous effects. This cutaneous emphysema is, however, sometimes observed in caseous pneumonia, without pneumothorax, in the case of a vomica reaching as far as the pleura pulmonalis, causing adhesions between this and the pleura costalis, and perforating both pleural folds at once. We can never, therefore, look on the cutaneous emphysema as a characteristic symptom of pneumothorax.

Simultaneously with the appearance of pneumothorax, and in pretty direct relation with the other symptoms of venous stasis, there is a diminution in the quantity of urine ; it becomes red and dense, and often contains, as urine in venous congestion generally does, small quantities of albumen. There are no other morbid symptoms connected with the nervous system or the

digestive apparatus, and characteristic of pneumothorax, which need be mentioned.

Pneumothorax is generally associated with displacement of adjacent organs. Inspection and mensuration show us that the affected side is more bulged than the other; the intercostal spaces also are stretched, and sometimes even forced outwards. The affected side moves less in inspiration than the sound side; sometimes it is quite motionless. On the contrary, we sometimes seem to detect a stronger expansion on the affected side, because of the fact that in the front of the chest wall the highest ribs are more strongly elevated than on the sound side; but, on closer examination, we notice that the whole of the rest of that side of the chest remains unexpanded, and that the phenomenon we have described depends on the circumstance that the inspiratory muscles on the affected side contract more strongly, and therefore the upper ribs simply are more raised than those on the sound side.

The pectoral fremitus cannot be estimated in cases which run a rapidly fatal course, on account of the weakness or loss of voice; in other cases, it is either entirely absent or very considerably weakened on the affected side. But we must not conclude because of the presence of pectoral fremitus, that the stratum of air is a small one. I have frequently convinced myself of the fact that pectoral fremitus may be present even when there is a great accumulation of gas in the pleural sac; it is then probably conducted from the healthy lung, or from parts of the affected lung adherent to the wall of the chest. For where the lung is fastened to a part of the chest wall by adhesions of the pleural folds, their vocal vibrations not only exist, but are often of normal, and sometimes even of abnormal, strength. Hence vocal fremitus is rarely quite absent at the posterior wall of the chest, where the lung lies closely compressed against the spine.

If there is fluid as well as air in the pleural sac, the pectoral fremitus will not be influenced by it, but one notices in the intercostal spaces, corresponding to the situation of the fluid, a greater resistance on palpation, which (as changes of position of the patient change the boundary level of the fluid, according to

the laws of gravity) sometimes enables us to define pretty accurately the limits of the exudation.

The evidences of displacement of adjacent organs, which are afforded by inspection, palpation, percussion, and eventually also by auscultation, are in no respect different from those described under pleuritic exudations, and need not therefore be dwelt upon again.

But we do not find expansion of the chest wall and displacement of adjacent organs in every case of pneumothorax. This will entirely depend on the tension of the air in the pleural sac. Should this be slight, we shall find valuable diagnostic support in the little expansion of the affected side in breathing, and in the absence or diminution of the pectoral fremitus, as ascertained by inspection and palpation.

Sometimes also the thorax, in spite of the existence of pneumothorax, is abnormally depressed. This is generally observed either after the radical operation for empyema, or when an empyema bursts into the bronchia, or when, after this accident has happened, the radical operation is performed as a supplementary measure, and occasionally even when the empyema has made its way out externally, although in the latter case the canal through which the pus passes, as we have already said, is narrow and sinuous, so that, as a rule, the air from without cannot enter the pleural sac.

The signs appreciable by inspection and mensuration are, as soon as the thorax wall has sunk in, the same as in purulent pleuritis with *rétrécissement thoracique*. If the affected side of the chest is just sufficiently movable, in inspiration and expiration, to allow of the ingress and egress of small quantities of air through the external opening, then the existence of these currents can be prettily shown by means of a light feather, the flame of a candle, and the like. The palpation signs are usually the common ones; but there is nearly always a feeling of greater resistance, on account of the pretty constant existence of thick membranes.

The resonance on percussion, at the places where the air lies next to the wall of the chest, is abnormally loud, deep, and tympanitic, and it is only occasionally, when the tension within the

pleural cavity is very great, that the tympanitic note is absent. This abnormally loud and deep resonance, spread over the whole side of the chest, is one of the most characteristic signs of the presence of pneumothorax. This resonance extends also abnormally low down, so that in right-sided cases the liver may lie quite outside the osseous thorax, and in left-sided cases the semilunar space may quite disappear ; at the same time the abnormally loud and deep resonance frequently extends beyond the sternum and encroaches upon the healthy side as far as the parasternal line and beyond it. Sometimes, on strong percussion, the sound has a metallic echo ; but this is only to be heard generally when we auscultate, and, therefore, in so-called *auscultatory percussion.* We place the stethoscope on one part of the chest, and strike the wall of the chest at another part with the broad surface of the plessimeter ; in this way we best throw the contained column of air into oscillation. It is here immaterial of what substance the plessimeter is made. We do not always hear the metallic clang in the lifetime of the patient, but it is almost always discoverable in the dead body. The conditions which here come into consideration have been stated with great clearness by Traube.[1] The reflection of the waves of sound in the pleural sac is necessary to the production of the metallic echo, and for that a certain degree of tension of the surrounding walls is needful. If this degree is exceeded, the phenomenon can no longer be elicited ; therefore it is that it often fails during life. By the cooling of the gas after death the tension must obviously be reduced, and it will then become just sufficient to enable us to hear the metallic clang again. Experiments, easy of repetition on the dead body, give complete proof of the accuracy of Traube's views. The tension is sometimes, however, too slight to make the reflection of the sound waves in the pleural sac possible, or, in other words, to produce the metallic echo by auscultatory percussion. Biermer has called attention to the fact that the metallic clang of a pneumothoracic space is several tones deeper in standing than in lying. The cause of this he believes to be the lengthening of the column of air through pressure on the diaphragm in standing.

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[1] Beiträge, II., p. 1034 et seq.

The appearance of the metallic echo is quite independent of the question whether there is fluid as well as air still in the pleural sac. The percussion sound, on the contrary, is naturally very much influenced by the co-existence of fluid effusions. Wherever these lie close beneath the wall of the chest the sound is intensely dull and forms quite a sharp contrast with the abnormally loud and deep sound, which is always heard when air lies immediately under the thoracic walls. Every change of position of the patient is attended with a change in the level of the exudation, and a consequent modification of the area of dulness. If the pneumothorax has been caused by the rupture of an empyema into the bronchia, and if purulent discharges still take place with fits of coughing, then, after every such discharge, the dulness assumes a discernibly lower limit. Should the wall of the chest be lined at any spot with thick membranes, then the resonance will not be very loud and deep, even if pneumothorax be present. If a communication exists between the pleural sac and the outer air through an aperture of any considerable size, then we shall get, on percussion, an exquisite *bruit de pot fêlé*, which again disappears when the aperture becomes firmly closed. Nothnagel has observed this in cases of recent penetrating wounds in the chest. We hear it most beautifully some days after the radical operation for empyema has been performed, and the incision in the chest is still wide open. It is evidently caused by a portion of the air contained in the pleural sac being driven through a narrow aperture by the percussion blow.

By means of succussion, *i.e.*, giving the patient a slight jog, a proceeding formerly commended by Hippocrates, and which is best carried out by laying hold of him by the shoulders with both hands, and communicating a few short movements to the thorax, then if there are both air and fluid together in the pleural sac, usually a clear, metallic, splashing sound is produced, similar to that caused by pouring fluid into a partially filled jar. Sometimes a sudden shake or turn on the part of the patient himself will produce this. This sound is sometimes entirely absent, and for the same reasons that the metallic echo is sometimes absent on auscultatory percussion; sometimes it

can only be heard when we listen directly for it; in other cases again it is so intense, that it can be heard at the other end of the room.   Occasionally, also, we can feel plainly the washing of the fluid against the wall of the chest.   Sometimes the patient himself, when he moves, hears the metallic splashing.

All the auscultatory phenomena which arise in the lung, the bronchi, the larynx, etc., external to the pneumothoracic space, take on a metallic reverberation, when between the patulent bronchi or vomicæ, etc., rendered more capable of sound conduction by compression, infiltration, hepatization, etc., and the air-containing pleural sac, the layers of lung tissue are not so thick as to greatly weaken or entirely prevent the transmission of the resonant vibrations.   Since patients under the given conditions are for the most part very weak-voiced or quite aphonic, and as the dyspnœa is great and the respiratory movement arrested, we may often hear nothing whatever on the affected side, or only an aphonic expiratory murmur, and occasionally dry and moist râles, or, if the pneumothorax is on the left side, the heart-sounds with metallic resonance.   If there is a considerable amount of fluid in the pleural sac, in addition to the accumulation of air, then we often observe the metallic phenomena that may be present much more clearly when he is sitting up than when he is lying down.   This is due simply to the fact that in the latter position a larger stratum of fluid intervenes between the lung and the wall of the chest, and then, when he sits up, sinks down, and thus keeps the lung and thorax wall further apart.   Under these circumstances we sometimes also hear Laënnec's *tintement métallique* (metallische Tropfenfallen).

Complications and Sequelæ.

All those diseases which we have mentioned as possible causes of the entrance of air into the pleural sac may be looked upon as complications of pneumothorax, and we need not now repeat them.   Pleurisy may be spoken of as a sequela, and of its course we have already treated.

Diagnosis.

Dyspnœa coming on suddenly, accompanied with pain, dila-
tation of the thorax, displacement of the diaphragm and heart,
a metallic clang, and deep, tympanitic percussion resonance,
merging below in an area of dulness, the level of which changes
with the position of the patient, succussion sounds; all these
evidences, when they coexist, establish pretty clearly the diag-
nosis of pneumothorax or pyopneumothorax. If, however,
very isolated symptoms are observable, and especially if the
metallic phenomena are entirely absent, then an error in diag-
nosis may very easily be made. This remark applies particu-
larly to circumscribed pneumothorax, the diagnosis of which I
take to be very uncertain in most cases.

The conditions most likely to be confounded, diagnostically,
with pneumothorax are large vomicæ, as they frequently occur
in caseous pneumonia, and more rarely in connection with gan-
grene of the lung, pulmonary abscess, and bronchiectasis. The
former are, as a rule, limited to the upper part of the lung,
whereas pneumothorax is scarcely ever so restricted. In pneu-
mothorax metallic phenomena of some kind or other are almost
invariably present, and the same is often also the case with large
vomicæ; but in the former case the chest wall is usually greatly
dilated, in the latter it is retracted; in the former we generally
perceive succussion sounds, at any rate when fluid is present at
the same time; in the latter it is quite an exceptional phenom-
enon; in pneumothorax the pectoral fremitus is either quite
absent or very considerably weakened; in the case of large
vomicæ it is generally not weakened and may even be increased.
If, however, the healthy tissue of the lung below the large
vomica has suffered extreme compensatory distention, then the
percussion sound may become abnormally loud and deep, and
reach unusually low down, while displacement of the heart
towards the other side may be produced by retraction of the
other lung. If we get this percussion sound in a man with
extreme dyspnœa, and who is so weak that the test of pectoral
fremitus cannot be applied, and in whom, together with com-
mencing stertor, a metallic clang may be heard in any part of the

chest on auscultatory percussion, we are in the habit of considering ourselves justified in diagnosticating pneumothorax, and even here we may be in error, as is clearly seen from what we have just said. I have myself twice made this mistake, and I have since become incomparably more cautious in diagnosticating pneumothorax. This is all the more imperative before we accept the existence of a circumscribed pneumothorax, for in this case, even if all the symptoms are present, they are less marked, more especially the signs of displacement. Even the Hippocratic succussion sound is not, as many suppose, characteristic of pneumothorax. It may be heard in some cavities which contain a great deal of secretion. I observed this two years ago, in a consumptive girl, twenty three years of age, who died in the Charité, in whom, on autopsy, no pneumothorax was discovered, but only an enormous cavity in the upper part of the right lung, whence proceeded the succussion sound.

When there is considerable retraction of the left lung, and, in consequence, a greatly elevated diaphragm and distended stomach, succussion sounds may be heard over the latter organ, and this, taken in conjunction with the absence of respiratory murmur, and perhaps the transmission of the râles (generated in the contracted lung) through the stomach, with a metallic reverberation—as well as the presence of an abnormally loud, deep, tympanitic percussion sound—will often mislead beginners into making a diagnosis of pneumothorax ; but the simple consideration of the course of the disease, of the retraction of the chest, of the absence of cardiac displacement, etc., ought to afford sufficient protection against such an error. If we wish to be quite certain, we may, in addition, follow the advice of Piorry, and make the patient drink a large draught of liquid ; by this means, if the above phenomena proceed from the stomach they will be made to undergo a very striking change.

Still less likely are we to find any difficulty in distinguishing it from simple enlargement of the lung, the falsely so-called emphysema of the lung. For this is commonly double-sided, and is very slow in developing. It leads, as a rule, to much less displacement of the diaphragm ; distinct pectoral fremitus is to be felt, and breath sounds without any metallic resonance may

be heard, although the percussion sound over the lungs appears sometimes as loud, deep, and tympanitic as in well-marked pneumothorax.

Wintrich mentions yet another case in which he erroneously diagnosticated pneumothorax : it was a case of perforating ulcer of the stomach, in which the perforation communicated with the sac of an abscess situated between the diaphragm, liver, and spleen. This is naturally a very rare event, and not very likely to come under observation again.

In the diagnosis of pneumothorax, as well as in all other cases, we must lay to heart the old medical axiom, not to attach too great a value to individual symptoms—and in this case, especially, to the metallic phenomena—but always base our diagnosis on the sum of the symptoms. The greater the number of the positive symptoms of the disease on which it is based, the more certain will our diagnosis be.

Duration, Results, and Prognosis.

The duration of the disease depends, in the first place, upon whether it has arisen in a previously healthy person, in consequence of a wound, or whether it is secondary, and has come on in the course of a serious primary affection. In the latter case it will depend on the severity of the primary illness, and at what stage of it the pneumothorax appeared. We must also take into consideration the amount of the gas and the rapidity with which it accumulated, the compression of the lung, and afterwards of the adjacent organs ; the extent of the secondary pleuritic exudation, and finally, the general condition of the patient.

Death may sometimes occur a few minutes after pneumothorax has set in. The danger is greater the more powerful and more robust the individual, and the less accustomed he is to pulmonary insufficiency, as we have pointed out more circumstantially when speaking of dyspnœic symptoms. In other cases the patient may live for weeks, months, and even years, so that it seems impossible, in general, at the beginning of a pneumothorax, to determine what may be its precise course ; and in the same individual case we may meet with the greatest

fluctuations in the severity of the local as well as the general symptoms, without, at any time, being justified in coming to any definite conclusion as to the further duration of the illness.

Death is the most common result. If the pneumothorax has been caused by gangrene of the lung, the fatal event usually occurs within the first twenty days. The fatal result may be deferred for months, if it depends on the entrance of air into the pleural sac, as an event of pulmonary consumption, or if it is caused by the secondary development of a purulent or ichorous pleuritic exudation.

Recovery is a much rarer event, and it is either incomplete, —that is, when the original disease is not overcome, as in caseous pneumonia,—or it is complete, as in the case of traumatic pneumothorax, or in those cases in which an empyema discharges itself into the bronchia. In the one series of cases the perforated openings close up, and the gas in the pleural cavity is gradually absorbed; thus we may sometimes discharge consumptive patients, who have come under hospital treatment for pneumothorax, in a few weeks as cured, that is, incompletely cured. If a pneumothorax arises in the course of a purulent pleuritic exudation, in consequence of its rupture into the bronchia and admission of air into the pleural sac, a perfect cure may often be brought about by the radical operation for empyema, as we have already mentioned, if no complication spring up.

It is clear from what has been already said, that in individual cases of pneumothorax, when we are not fully acquainted with the particular conditions on which it depends (and even in cases where this is possible) the prognosis must often remain doubtful. Generally it must be very unfavorable, but less on account of the mere presence of air in the pleural sac than on account of the incurable and dangerous nature of the original maladies. The extension of the pneumothorax, the pressure which it exercises on important organs, and the consecutive results (purulent or ichorous formations in the pleural cavity, etc.), will naturally influence considerably the prognosis. The prognosis is relatively most favorable in traumatic cases, and cases which have arisen out of a purulent pleuritis; it is least so when the primary disease is gangrene of the lung or cancer of the œsophagus.

Treatment.

In the different forms of pneumothorax treatment must in the first place be directed to the original diseases, and to the secondary pleuritis, with its various consequences. This, of course, is not the place to discuss the treatment of the original diseases, and, with regard to pleuritis, we must refer generally to what has already been said on that subject. As soon as a pyothorax has become a pyopneumothorax, in consequence of the discharge of a purulent pleuritic exudation into the bronchia, then we must not lose a moment's time in performing the radical operation by incision. The earlier this operation is undertaken, the more favorable are the results we may expect from it. The same advice applies to traumatic cases of pyopneumothorax. As soon as this view obtains universal acceptance in our field-hospitals, the results which attend penetrating wounds of the chest will take a more favorable form. It must be admitted that every such case requires for its perfect treatment (and that alone furnishes success) an enormous expenditure of time, and this, in the first days and weeks which follow a battle, is only too sparingly measured out to the overworked ambulance surgeons.

It is much more difficult to determine whether we should or should not operate in those cases in which a purulent pleuritic exudation is superadded to pneumothorax, when this has been caused by some internal malady, as is most frequently the case with phthisical patients. In favor of operating it may be urged, in the first place, that the patient often suddenly relapses when a purulent pleuritis develops, even when the lung disease is not very far advanced ; and, in the second place, that the exudation frequently reaches such a height that danger to life necessitates an operation. Against operating, however, it may be stated that consumptive patients ofte nlive for years with a pyopneumothorax, if the absorption of pus be prevented by the pleural cavity becoming closed over with a thick pyogenic membrane, and thus the occurrence of purulent fever has become impossible ; while on the other hand they generally succumb very rapidly after the radical operation, through ichorization of the

pleural cavity, to prevent which, in such cases, all our care in
dressing, and all disinfecting agents have proved of no avail.
In my own mind, since I have adopted the method of treating
purulent exudations which I have already described, the ques-
tion is not yet decided one way or the other, for I have had but
few opportunities of carrying out the after-treatment I have
detailed in cases of this kind.   Such experience as I have
hitherto had has been unfavorable, and would lead me to
abstain from the operation, unless it was rendered imperative
by the presence of symptoms dangerous to life, for hitherto such
patients as I have operated on in the circumstances described
have all sunk rapidly.   In future I should not unhesitatingly
attempt the radical operation, except in cases where the primary
lung affection had made but very little progress, and especially
when the uncompressed lung remained free from disease.   In
such cases I should attempt it, even if there were no immedi-
ately threatening symptoms present.   As to the escape of gas
itself, and its effects, we can only here speak of a symptomatic
and palliative treatment.   To relieve the pains which are pres-
ent at first, and the distressing dyspnœa, we should use small
subcutaneous injections of morphine.   The patient should also
be dry-cupped, and if he be still strong and well nourished,
some blood may be taken at the same time, with the view of pre-
venting the supervention of secondary pleuritis, or at least
moderating its development.   We should give mild antiphlogis-
tic remedies internally, especially potassium or sodium nitrate
(a drachm and a half to about three and a half ounces of water).
Even in cases attended with extreme dyspnœa I would not
recommend venesection, because it could at best produce only
transient relief, and is always attended with the danger of
increasing the tendency to collapse.

When the first and most pressing danger is over, we must be
careful to order the patient a nourishing diet, easy of digestion,
and to take care that the bowels are daily relieved by enemata.
If we do not attend to this last point, an increase of dyspnœa
often comes on in consequence of constipation.

If death from suffocation seems imminent on account of the
pneumothorax, a portion of the air must be let out by punctur-

ing the pleural cavity with a capillary trocar. We may in this way succeed, at least for a time, in averting the danger which threatens the patient's life. The operation can, of course, only be of use when the wound in the pleura, through which the air has entered the pleural sac, is closed again, and the pressure within the pleural cavity is greater than under normal conditions. It is impossible to ascertain both these points before operating. There are no data whatever for determining the first; with regard to the second, the principal indication is derived from the displacement of adjacent organs, but this is often very considerable in protracted pneumothorax, without the pressure within the pleural cavity being greater than that of the atmosphere; in other rare cases, however, no symptoms of displacement exist, while the tension of the gases contained in the pleural sac is very considerable.

We rarely obtain a favorable result if we are compelled, on account of threatening asphyxia, to puncture the chest even after the onset of pneumothorax, because the pleural wound is not yet healed. If, however, the perforation be very small, and readily united, the healing process is generally complete in three or four days, and by this time there is, as well as considerable displacement of adjacent organs, almost always a great amount of intra-pleural pressure. At this time, therefore, we obtain the best results by puncture. It is, therefore, my habit, when a pneumothorax comes under my treatment from four to eight days after its onset, and is attended with evident displacement of adjacent organs, to puncture, even if there is no present danger to life, because by so doing we greatly diminish the pressure on the sound lung, and on the heart, and after we have let out a portion of the air the remainder will naturally be absorbed more easily and rapidly. Proof that I have obtained good therapeutic results in this way may be found in Baerensprung's [1] inaugural dissertation, in which a series of cases treated by me in this way are cited. Should the pleural wound be very large, and not closed, puncture with a capillary trocar has no kind of ill effect.

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[1] Zur operativen Behandlung des Pneumothorax. Berlin, 1873.

I am in the habit of using in this operation my capillary trocar which I have already described, and I cover its lateral opening with a piece of gold-beater's skin. The trocar, in the manner before described, is introduced between the fourth and fifth ribs, somewhat outside the mammary line, the stylet is drawn back, and then the top of the lateral tube is opened, while the end of the gold-beater's skin is sunk in water. We then see the air escape out of the water in separate bubbles, until the pressure within and without the pleural cavity is equally balanced. During inspiration the gold-beater's skin acts as a valve, and applies itself to the opening of the lateral tube, so that neither air nor water can be drawn into the pleural cavity from without. When this point is reached we remove, in the manner already mentioned, the trocar from the pleural sac, and close the little puncture-wound with a strip of adhesive plaster, and apply an ice-bladder to the wound for twenty-four hours, keeping the patient completely quiet.

It is not unusual for violent fits of coughing to come on during the escape of the air, as in the withdrawal of pleuritic exudations. Should this be the case, do not remove the trocar till the cough has entirely ceased, and for this purpose administer subcutaneous injections of morphine; or, remove the instrument and compress the passage it has made, for a time, until every trace of irritative cough has disappeared. If we are not careful about this, then air passes out of the pleural cavity in coughing, enters the canal made by the puncture, and thence passes into the subcutaneous connective tissue. The cutaneous emphysema which is thus produced sometimes spreads with remarkable rapidity over the greater part of the body, and proves most distressing to the patient. Since I have carefully attended to the above precautions, I have never again had to deal with this troublesome complication.

I have never ventured to carry out the idea of removing the air from the pleural cavity by aspiration, after the manner of treating pleuritic exudations, even when the pressure within it is not greater than that of the outer air, because, by so doing, we run the risk of again tearing open the only partially healed perforation, and thus again allowing air to enter the pleural sac

from the lung. But nevertheless puncture in pneumothorax, when practised in accordance with correct indications and with proper precautions, will prove of real service in a not inconsiderable number of cases.

TUBERCULOSIS OF THE PLEURA.

In ordinary manuals tuberculosis of the pleura usually has a separate chapter devoted to it, and for that reason I shall here mention it briefly, although it has no claim to be considered as a distinct form of disease.

In general acute miliary tuberculosis, small transparent gray nodules are developed in the tissue of the pleura, together with recent tubercle in the lungs and various other organs. In such cases the patient dies without the tuberculosis of the pleura giving rise to any distinct local symptoms. It is more common, however, for tubercle to be deposited in the recent false membranes produced by pleuritis, either as associated with caseous pneumonia or genuine tuberculous processes in the lungs, or in connection with tubercle of other organs; or, as sometimes happens, especially with old people, the tubercle first appears in this situation. In this case the tubercles appear as prominences not bigger than a millet-seed or a hemp-seed, at first of a whitish-gray, and subsequently more of a yellowish-gray color.

We have already mentioned that in this form of pleuritis the exudations are often hemorrhagic, because of the abundant development of vessels which takes place in the pseudo-membranes. When by puncture we have ascertained that the exudation is of this character, or when we are justified by the general symptoms in suspecting it, we may assume, with much probability, that it is a case of tubercular pleuritis. We have already spoken fully of the symptoms of this disease.

MALIGNANT NEW-GROWTHS IN THE PLEURA.

Sarcoma—Cancer.

Sarcomas or cancers of the pleura are never primary, but always follow the development of tumors of a like nature in

neighboring organs.   It is therefore impossible to give any
general description of these new formations in the pleura.

We are equally unable, in this place, to give an accurate
anatomical account of the various kinds of tumors.   We may
state, however, that sarcomas are much more rarely found than
cancers.   In the first place, the new-growth may advance into
the pleural cavity from without, attacking first the costal pleura,
perforating it, and invading the pleural sac as a tumor of the
most varied form.   Or it may originate in the lung, and first
appear in the pleura on the free surface of its pulmonary layer,
growing out in the form of nodular tumors, varying in size from
that of a hemp-seed to that of a child's head.   The nodules
themselves are sometimes flattened, but more frequently they
are rounded, prominent, and often highly vascular, and usually
speckled.

If the pleural folds are not closely united by adhesions, fluid
secretions almost invariably accumulate in the pleural sac,
which, for the most part, are only transudations.   In such cases
genuine pleuritis, as a rule, only arises when ichorous or slough-
ing tumors of external parts, as, for example, of the mamma,
or of the axillary glands and the like, force their way into the
pleural sac ; or when pleuro-pneumonia occurs as a secondary
complication of cancer of the lung, or finally, when pleuritis
supervenes on the existing hydrothorax.   If tumors of the
pleura are very large, they may not only compress the lung
to a great extent, but displace all the adjacent organs, and
thrust out the chest wall.

Symptoms.

The smaller tumors of the pleura will often during life give
rise to no distinct symptoms.   The larger ones are accompanied,
as we might naturally suppose, not by febrile movement, but by
more or less severe attacks of dyspnœa, sometimes coming on in
paroxysms, sometimes continuous.   Patients often suffer from
dysphagia at the same time.   When there is pain which cannot
be referred to coexisting pleuritis, it is of a dull character and
accompanied by a feeling of weight.   We are greatly aided in

our diagnosis if the patient presents an appearance of maras-
mus ; if there is great emaciation ; if the skin is dry and of a
dirty, yellowish-green color. At the same time, œdema of the
upper extremities and of the face, and in other cases slight _
œdema of the joints, sometimes occurs. Enlargements of single
superficial lymphatic glands are always noteworthy symptoms.
The diagnosis is naturally rendered much more certain if we can
also detect clearly the existence of cancerous or sarcomatous
tumors in any part accessible to direct observation.

It is only when the tumors are large that physical examina-
tion of the organs of respiration is of much use to us. Then it
is not unusual to find the wall of the chest bulged out on the
affected side, the heart displaced laterally, and the diaphragm
pushed downwards. The test of pectoral fremitus, in these cases,
affords no certain evidence, for sometimes it is quite normal, some-
times it is weakened, and sometimes it is even entirely absent,
according as the substance of the tumor is capable or not of con-
veying the vocal vibrations. Occasionally hydrothorax happens
to be present and quite destroys the fremitus in the lower parts
of the chest. If large masses of the pleural tumor lie imme-
diately beneath the wall of the chest, at such spots the per-
cussion sound is intensely or absolutely dull, and the feeling
of resistance, especially on palpatory percussion, is remark-
ably great. Respiratory murmur is entirely absent. If cough
exists at the same time, it is dependent on some casual affec-
tion of the bronchi. If there is any expectoration, the sputa,
having no connection with the new formation in the pleura,
possess no diagnostic value.

Diagnosis.

We should very frequently fall into error if we were to arrive
at the positive diagnosis of a pleural cancer or a pleural sarcoma
from the symptoms we have here set forth. Before we venture
to think of the existence of a pleural tumor we must always be
careful to exclude the presence of extensive caseous pneumonic
infiltration of the lung, or pleuritic exudation, with either of
which we may possibly confound it.

Widespread and obstinate caseous pneumonic infiltrations rarely occur when malignant new-growths exist in any other place, although Rokitansky's exclusion theory with regard to cancer and caseous pneumonia, cannot be unconditionally accepted; caseous pneumonias produce no displacement of adjacent organs, they are often double-sided, often associated with the formation of vomicæ, and they seldom give so absolutely dull a percussion sound as we find over pleural tumors. In the latter case we get no nocturnal perspirations, while we often find signs of compression of the superior vena cava and the œsophagus.

The differential diagnosis between a pleuritic exudation and a pleural tumor is, under certain circumstances, much more difficult, especially when the latter is combined with hydrothorax.

In the case of a tumor the area of dulness is, as a rule, not bounded by so regular an outline, and, moreover, the dulness is not always most intense at the lowest parts of the chest, nor do changes of position on the part of the patient modify the area of dulness. Striking fluctuations in the boundaries of the dulness, which we usually observe sooner or later in the course of a pleuritic exudation, are absent in pleural tumors.

A pleural tumor can only be mistaken for an aneurism when it presses on the lung and is so situated in front of the heart or great vessels that it conveys a visible or tangible pulsation to the wall of the chest. A further careful investigation of the case will usually save us from error.

We can never, however, be in a position to decide with certainty whether such new formations are connected with the pleura or the lung, or with some other intra-thoracic structure.

Duration, Results, Prognosis.

The duration of a malignant new-growth in the pleura depends exclusively on the stage of growth of the primary tumor, and the rapidity of increase of the pleural nodules. The result is, as in all malignant tumors, fatal, and the prognosis, therefore, absolutely unfavorable.

Treatment.

There is no special treatment for malignant growths in the pleura. We must enforce a suitable dietetic regimen, and, in the somewhat rare event of the occurrence of violent pain, administer opiates or subcutaneous injections of morphia.

INDEX.